ORDNANCE

LAND · SEA · AIR

New Antitank Weapon

JANUARY-FEBRUARY 1956

(In two sections: Section I)

Grinds breech of 4,000 lb. gun barrel

TIMKEN® bearings on work spindle hold runout within .0007"

THIS Bryant Internal Grinder does parallel and tapered grinding jobs —often to a depth of 48"—in the breech end of 4,000 pound gun barrels. To give high accuracy and stability under heavy loads, the huge work spindle is mounted on Timken® tapered roller bearings having a 24" bore and 32" O.D.

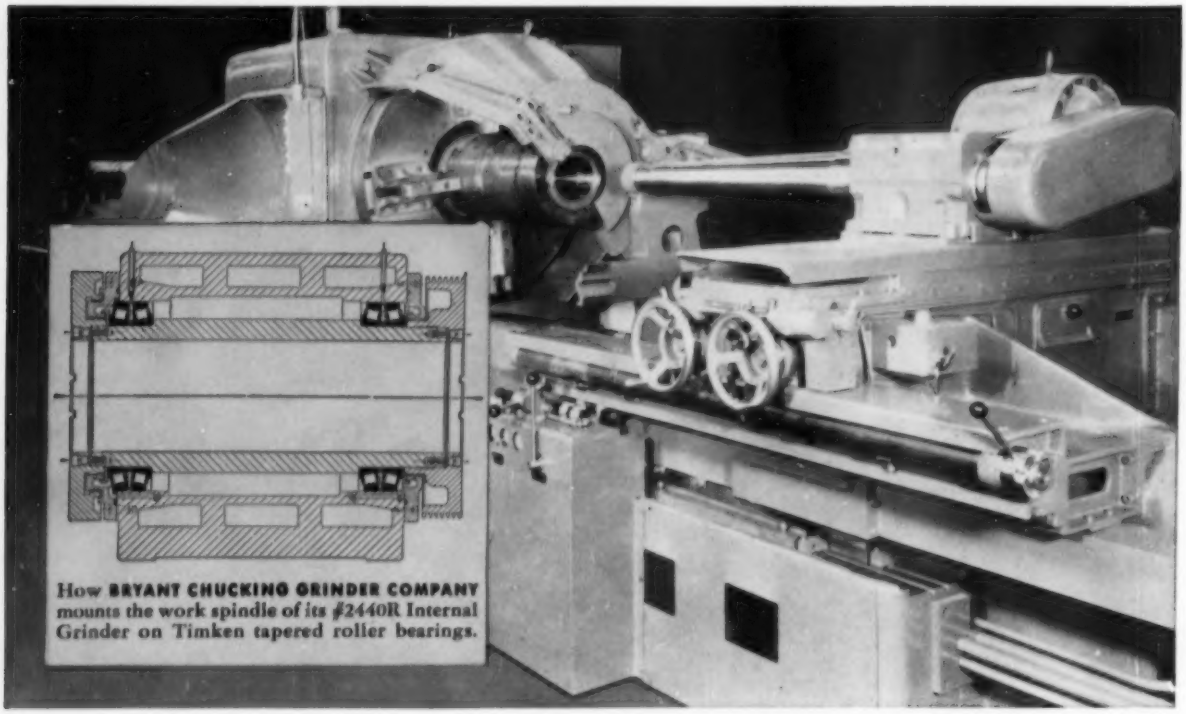
Due to their tapered construction, Timken bearings take radial and thrust loads in any combination. Spindles are held rigid, runout doesn't exceed .0007". And because of line contact between the rollers and races, Timken bearings have capacity to spare.

Both Timken bearings on the work spindle are mounted with cone spacers so that no manual adjustment is necessary. Spindle maintenance is simplified. And Timken bearings practically eliminate friction because they are geometrically designed to have true rolling motion and precision manufactured to live up to their design.

The end of the work spindle may possibly be bumped by the long, heavy gun tube when chucking a new piece. Timken bearings stand up to these shock loads because the rollers and races are case-hardened. This gives them hard, wear-resistant surfaces over tough, shock-resistant cores. What's more, we make our own steel to check quality every step of the way. No other U. S. bearing maker does.

Specify Timken bearings for the machinery you build or buy. Always look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **BRYANT CHUCKING GRINDER COMPANY** mounts the work spindle of its #2440R Internal Grinder on Timken tapered roller bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

REVOLUTIONARY BUCYRUS PLANT HELPS HOLD DOWN RISING COSTS

At a new plant in Bucyrus, Ohio, the Timken Company has substantially reduced the cost of tapered roller bearings by: 1) producing these bearings under a new system of extreme mechanization; 2) standardizing on 13 bearing sizes with the widest applications throughout industry. Manufacturers can take advantage of these lower costs by redesigning applications to use these Bucyrus sizes. And as more switch to Bucyrus bearings, production costs can drop still further, meaning even lower costs to you.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION

ORDNANCE

LAND · SEA · AIR

The Magazine of Scientific and Industrial Preparedness Now in Its 36th Year

VOL. XL JANUARY-FEBRUARY 1956 NO. 214

The Cover.—*The 90-mm. self-propelled antitank gun, T101, now under test, was developed to give our Airborne forces a hard-hitting mobile weapon for the assault phase of establishing an airhead. It weighs 15,800 pounds and can be dropped by parachute.*

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FEATURES

New Antitank Weapon . . . . . **Front Cover**
Photograph of the 90-mm. self-propelled T101 airborne gun

Hon. Wilber M. Brucker . . . . . **Frontispiece**
Exclusive Harris & Ewing photograph of the Secretary of the Army

The Army's Weapons . . . . **Hon. Wilber M. Brucker** 587
The ground forces' arsenal includes both time-tested and new ordnance

Strategy of Disarmament . . . . . **Eugene E. Wilson** 589
Limitation on the use of military power is the key to peace

Preserving Armament Skills . . . . **Harry L. Erlicher** 592
A plan for an emergency reserve of critical trained workers

Return of the Seaplane . . . . . **Joseph Goodyear** 593
Water-based aircraft may solve the problem of immovable airfields

The Logistical Line . . . . **Lieut. Col. Ralph R. Todd** 598
Problems of manning the extended and elaborate supply organization

New Army Matériel 601
Photographs of the new 8-wheel cargo truck and countermortar radar

Armament Preparedness 603
Account of the Thirty-seventh Annual Industrial Preparedness Meeting

Logistics in Atomic War . . . . . **Robert J. Icks** 604
Widespread decentralization has created unique supply problems

Are Planets Habitable? . . . **Maj. James R. Randolph** 608
Problems in determining accurately the oxygen content on other worlds

Refueling on the Fly 611
Photographs of the versatile F7U-3 Cutlass twin-jet fighter

Crozier House 612
Announcement of the gift of Mrs. Crozier's residence to the A.O.A.

New Lightweight Handguns . **Capt. C. B. Haslam, U.S.M.C.** 614
The current trend is toward less bulky automatic pistols

"Mystery" Bullets . . . . . **Col. B. R. Lewis** 616
A study of some of the unusual projectiles used in the Civil War

Recent British Aircraft 619
Photographs of the Handley-Page Victor bomber and the P-1 interceptor

The Price of Peace . . . . . **An Editorial** 623
The need to maintain national strength in an uneasy world

DEPARTMENTS

Atomic Energy	576	Armament Electronics	676
Month by Month	620	Rockets and Guided Missiles	682
Association Affairs	624	Recent Patents	686
New Developments	658	Book Reviews	690
Materials Progress	668	Index of Advertisements	727

ARMAMENT TECHNOLOGY

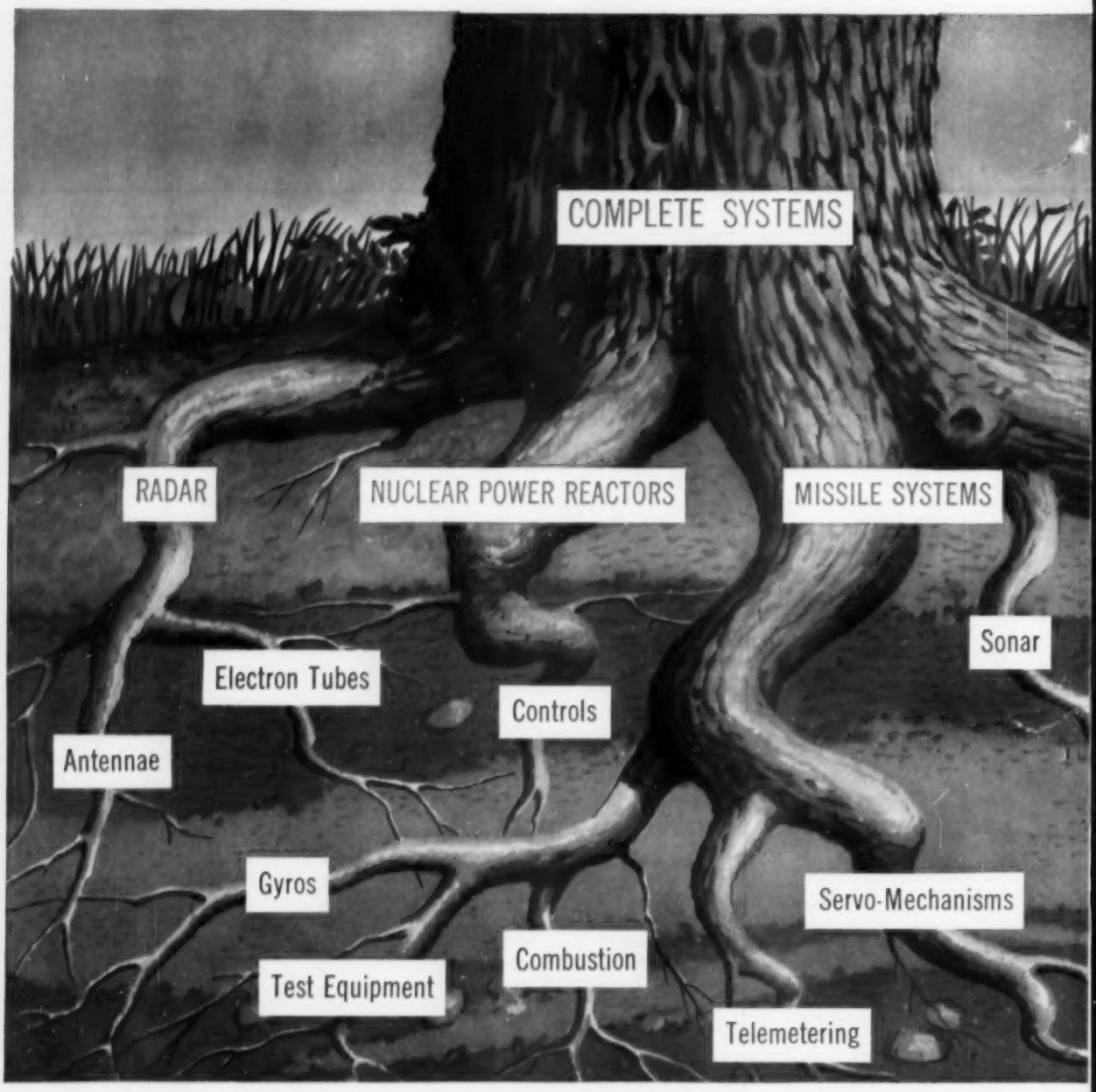
Military Electronics . . . **Lieut. Col. Leonard M. Orman** 709
Complex weapons systems must be designed for ease of maintenance

Ceramic Cutting Tools . . . . . **P. A. G. Carbonaro** 712
Sintered alumina tips can replace strategic tungsten-carbide steel

Powdered Metals in War . . . . . **John D. Dale** 714
They may solve problems of materials, labor, and know-how

Secondary Ordnance Items . . . . **Charles W. Fauroat** 719
Computation of requirements has been facilitated by new methods

Towed Gun Carriages . . . . . **N. S. Glassman** 723
In an all-out conflict, towed artillery has many advantages



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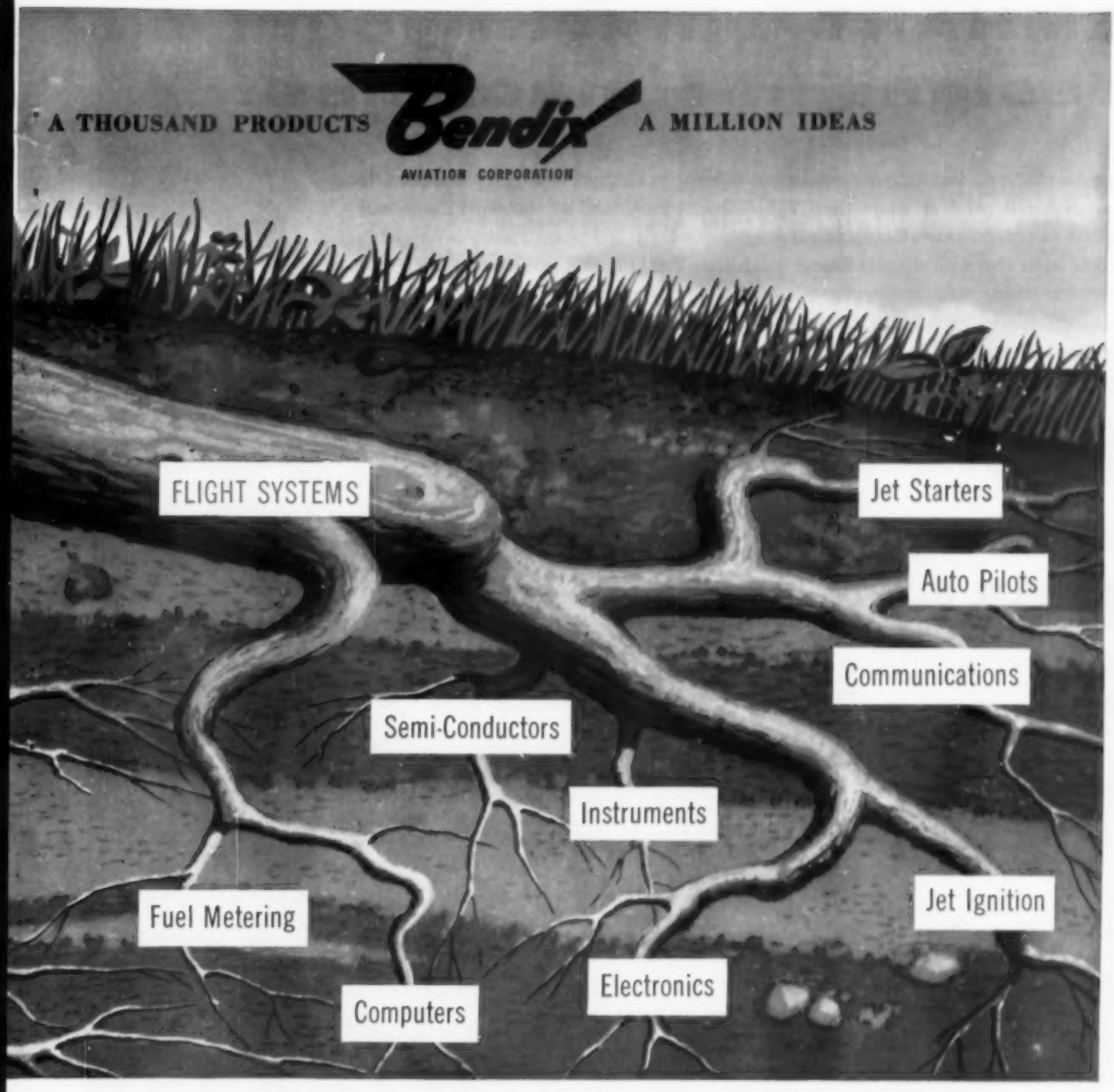

The more deeply rooted you are in all the things of which systems are comprised, the better able you are to produce completely dependable systems.

Having produced millions of components, subsystems and complete systems for many years, Bendix Aviation is the logical direction to look for systems to solve many current problems as well as others anticipated. Bendix assets for systems work include:

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SYSTEMS PLANNING GROUP—Coordinates major systems work, giving you a single, centrally located contact—the Bendix Systems Planning Group, Bendix Aviation Corporation, Fisher Building, Detroit 2, Michigan.

EMHART will turn your designs into machines

Engineering and building automatic machinery is Emhart's primary business. The four divisions produce more than 275 different machines as standard items and have a combined manufacturing experience of nearly 200 years. Henry & Wright makes high speed automatic dieing machines; V & O builds, tools and equips precision power presses. Standard-Knapp's packaging machinery is known to everyone who uses boxes, bags, cans or bottles for their products, and Hartford-Empire's glassmaking machines are preferred throughout the world.

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Here's What We Do!

Wolverine plain tube in both straight lengths and coils is available in a wide range of sizes in copper, copper alloys and aluminum.

Wolverine Trufin*—the integral finned tube—will save space, step up efficiency in heat exchange operations.

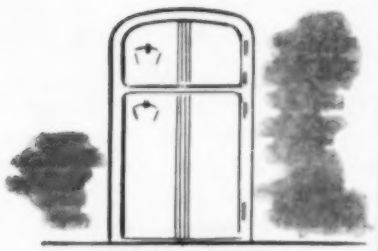
Wolverine produces millions of rotating bands each year. Sizes: 20mm, 30mm, 40mm, 75mm, 76mm, 90mm, and 105mm.

Wolverine through its exclusive Spun End Process** manufactures dependable, one-piece tubular-shaped parts, spun completely or partially closed to your specifications.

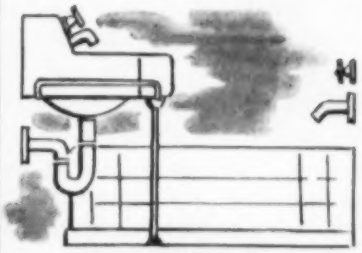
Wolverine can bend, spin, flare, bead, expand, reduce or otherwise fabricate tubing to your requirements.

Wolverine also specializes in the manufacture of extruded aluminum shapes.

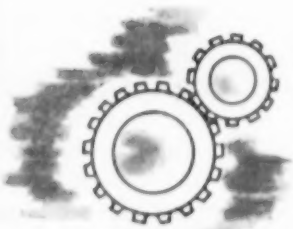
What Do You Do?



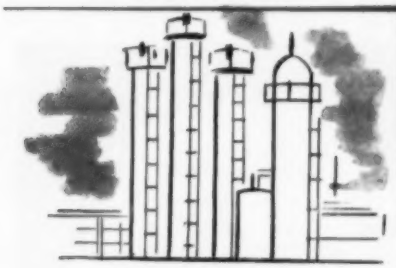
REFRIGERATION



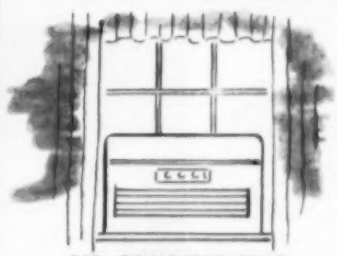
CONSTRUCTION



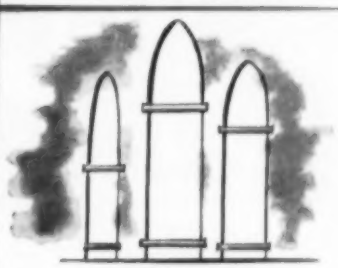
MANUFACTURING



PROCESSING



AIR CONDITIONING



ORDNANCE

Why Don't We Get Together?

If you are using tube, tubular-shaped products, or extruded aluminum shapes, it's sure as shooting that Wolverine can help save you time and money. You can get quick help from Wolverine's Field Engineering Service—a group of tube technicians who have the answers. Write for Wolverine's General Products Catalog—*right now!*
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Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario

*REGISTERED U.S. PAT. OFF.
**A PATENTED PROCESS RE. 22465

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Division of Calumet & Hecla, Inc.

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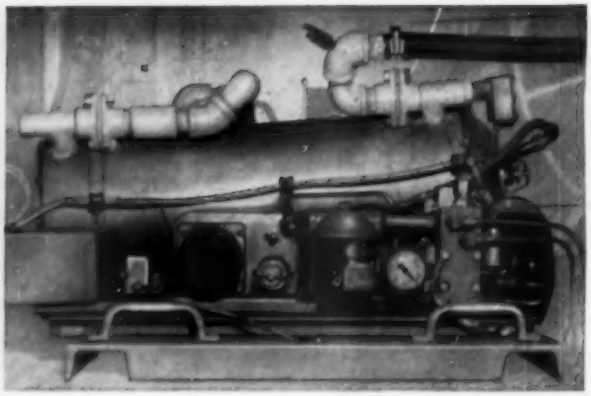


TYPE 0-6 CRASH TRUCK plus JANITROL LIQUID HEATER equals

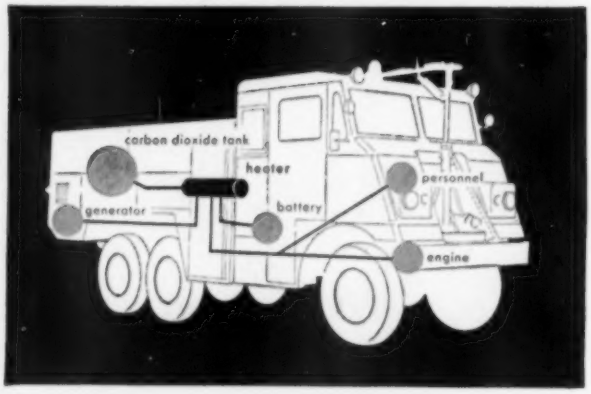
WINTERIZATION TO 65° BELOW ZERO

It takes just fifteen minutes for two men to install and connect, or disconnect and remove the Janitrol Liquid Heater equipped "winterization kit" in the Air Forces new Type 0-6 Cardox Crash Truck.

Cardox engineers took full advantage of Janitrol unit design accessibility . . . added a coolant pump, hand bypass pump, electrical over-ride connections, and an aluminum channel-iron skid base to come up with the ultimate in changeover speed. Just six quick-disconnect couplings tie coolant flow—electric supply—and fuel supply to the permanently installed winterization system within the truck. Operating controls are installed in the truck cab.

The Janitrol heater provides 90,000 Btu/hr for engine block, engine pan, battery box, radiator, cab and body, defrosting, a motor generator set, and the Cardox pressure vessel heating. Complete insurance against winter operating failures caused by freeze-ups!

Look into Janitrol Liquid Heaters' long record of dependability under all conditions—and you'll specify "Janitrol" for vehicle heat wherever and whenever needed.



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AIRCRAFT-AUTOMOTIVE DIVISION, SURFACE COMBUSTION CORP., COLUMBUS 14, OHIO

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AUTOFEED UNDERDRIVE

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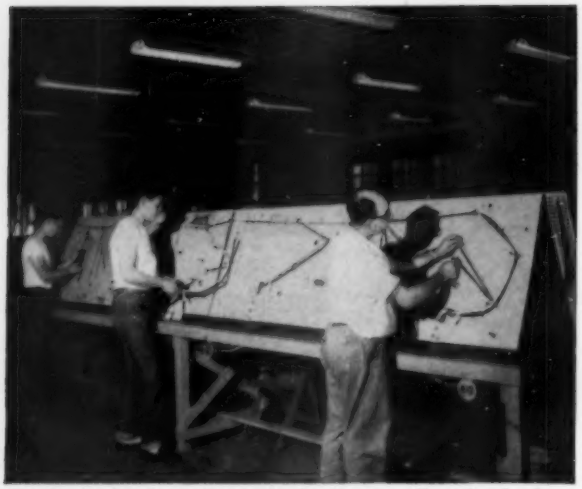

Wiring for intricate electronic circuits, as well as simple electrical systems, has always played a vital role in the great majority of ACF products and ACF-built military equipment.

Bombs and artillery shells which must be made to the most rigid specifications have been produced by ACF through both World Wars and during times of peace.

Design, development and production of fuses was a natural extension of the activities for the division which has specialized for 40 years in the manufacture of fuel system devices.

ACF modules—widely used throughout the electronics industry—are an outgrowth of their pioneering efforts in printed wiring, replaceable potted assemblies, diode shaping networks, etc.

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Every 3 seconds—a heated bar with this Magnethermic 10,000 cycle Induction Heater

This 10,000 cycle unit preheats 1" steel bars to 2300 degrees for upsetting at rate of one every 3 seconds or over 1,000 per hour.

Induction preheating for forging or extrusion has many advantages: speed, economy, cleanliness, close control, adaptability, increased die life and attractive working conditions.

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Bundy simplifies oiler-tube design, cuts fabrication time, trims costs

Another example showing how Bundy engineers help solve customers' design headaches

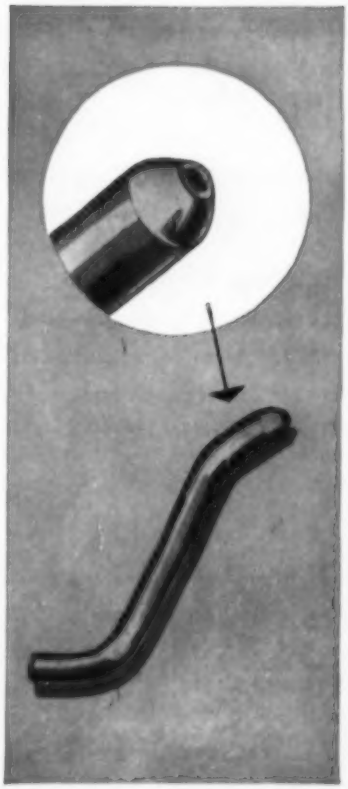
Naturally, doing everything we can to meet our customers' design specifications is a Bundy *must*. But sometimes our engineers—with their years of problem-solving experience—see ways in which original specifications can be improved. These improvements usually result in substantial savings to the customer, as in the example shown at right.

Doing just a little more than the job requires is an old habit with us here at Bundy. That's why you'll find it so rewarding to deal with us at the design stage of a new product.

Why not profit from an unbeatable combination: expert Bundy engineering services plus the priceless extra of Bundyweld Tubing—the only tubing double-walled from a single metal strip, copper-bonded through 360 degrees of double-walled contact. Bundyweld is leakproof; thinner-walled yet stronger; has high thermal conductivity; has high bursting strength. The safety standard of the refrigeration industry, Bundyweld *is used in 95% of today's cars, in an average of 20 applications each.*

Let Bundy help you with your tubing design problem. Call, write, or wire us today.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN



Problem: This 3/16" O.D. timing-gear oiler tube, shown above, required a tapered end for a nozzle effect. As specified by the customer, it required numerous swaging operations. Bundy engineers, always on the lookout for new ways to shave costs, hit upon the ingenious solution shown at right. With the customer's consent, original specifications were changed.

Solution: First, Bundy added upset to nozzle tip (see above). As a result, nozzle-forming operations were cut in half. But Bundy innovations didn't stop here; next, two hand-bending operations were incorporated into one automatic press operation. The over-all result: impressive fabrication savings to the customer, with no compromise in tubing function.

Bundyweld starts as a single strip of copper-coated steel. Then it's

. . . continuously rolled twice around laterally into a tube of uniform thickness and passed

through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint absence of bead, and less chance for any leakage.

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It saves money in paint shops!

Oakite Rustripper is an alkaline material that strips paint, pigment residues and phosphate coatings from steel at the same time that it removes rust and oil.

It saves money in plating shops!

Oakite Rustripper removes rust or heat scale from steel at the same time that it removes oil and other soils. It avoids hydrogen embrittlement, damage to machined surfaces and other disadvantages of acid pickling.

FREE

For more information about how Oakite Rustripper eliminates operations in paint shops and plating shops, send for one or both of the illustrated booklets listed in the coupon.

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Here's the best shortcut in the field of electroplating
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Paint Shop Men Save Time With New Kind of Stripper

INDIANA: "We formerly stripped TV cabinet rejects in 25 minutes. They came out a brown tarnished color... Had to pickle to remove phosphate coating... Today Oakite Rustripper strips the same cabinet in less than 10 minutes, bringing it out so bright and clean you can't tell it from a new one... Pickle, neutralize and rinses eliminated."

NEW YORK: "It used to take two hours to strip synthetic enamel from these rejects (filing cabinets). Now Rustripper does them in about two minutes. We used to soak conveyor chain links overnight and work hooks for several days. Rustripper does both jobs in two hours and cuts out the wire brushing for rust."

COLORADO: "We were amazed at the results... a perfect job of stripping gray OD enamel, red oxide prime and surface rust from bomb clusters. Oakite Rustripper is the finest material ever used here."

Send for free booklet "*Here's the best shortcut in the field of organic finishing.*" See coupon at left.

Electroplaters Find Profit in Alkaline Derusting

CALIFORNIA: "Formerly sand blasted the heat scale off these aircraft parts. Now the scale is removed in about 30 minutes with a boiling soak in Rustripper at 4 pounds per gallon, rinse, reverse-current clean, rinse; followed by cyanide dip and cadmium plate."

NEW YORK: Removing heavy heat-treat scale, rust and soil from steel aircraft parts before cadmium plating. Also cleaning stainless steel landing gear parts after hardening. Using 3 pounds Oakite Rustripper and 10 ounces sodium cyanide per gallon at 120°F. with periodic reverse current. "An excellent job is being done... Parts are being descaled that we couldn't touch without pickling in muriatic acid... Everyone astounded at life of solution, since this bath is worked very hard and former bath required heavy upkeep...: Appears likely to save about $2000 in first year."

CALIFORNIA: "Oakite Rustripper seems to be what hard chrome platers have been waiting for." Used for removing rust from steel shafts after chrome plating, baking, machining, etc., and before oiling. Rust was formally rubbed away with emery paper.

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- N-A-X ARMORPLATE
- N-A-X 9100 SERIES

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. . Meet necessary rigid standards

. . . Conserve critical alloys

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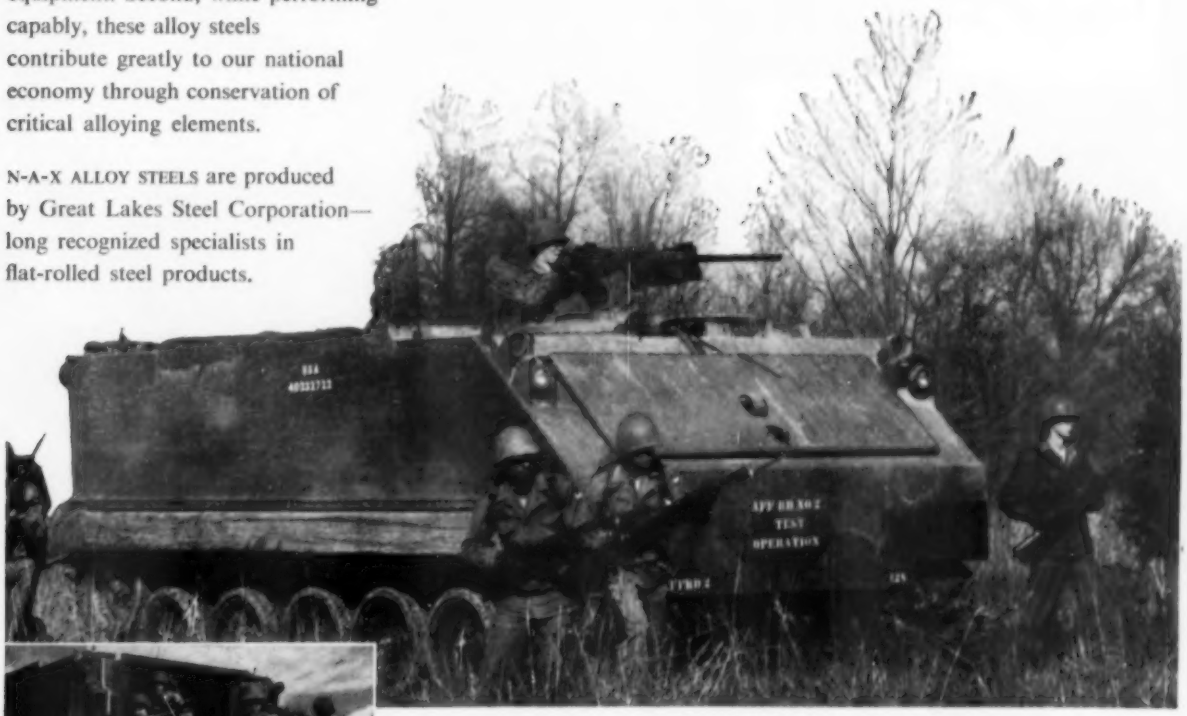
N-A-X ALLOY STEELS are produced by Great Lakes Steel Corporation—long recognized specialists in flat-rolled steel products.



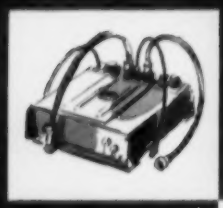
The M59 Armored Infantry Vehicle, designed and built for Army Ordnance by Food Machinery and Chemical Corporation, is an example of national defense equipment using N-A-X ALLOY STEELS.

An infantry squad leaving their M59 armored personnel carrier to assume battle positions, after being safely transported to the scene of action.

Although primarily a land vehicle, the M59 is capable of swimming rivers and lakes with ease, while fully loaded.

N-A-X Alloy Division
GREAT LAKES STEEL CORPORATION
Ecorse, Detroit 29, Mich. • A Unit of
NATIONAL STEEL CORPORATION

CORPORAL E



STAR PERFORMER

WITH PRECISION GUIDANCE

Motorola's precision engineering in the missile field has made a major contribution along with Jet Propulsion Laboratories in the development of Corporal E

navigational devices • radar • countermeasures • analog computers
communications equipment • digital computers • data transmission
data processing and presentation indicators
plotting systems • telemetering
remote control • servomechanisms
transistor circuitry • operations research
dynamic systems analysis • subminiaturization
solid state physics • semi conductor research • transistor development

Positions open to qualified Engineers and Physicists

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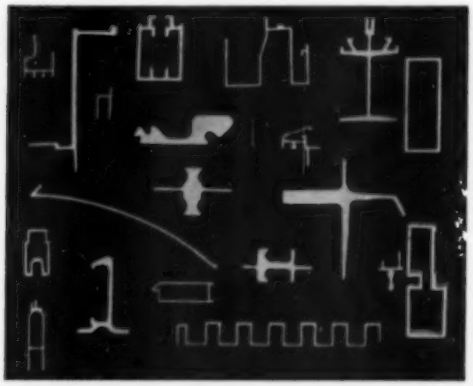
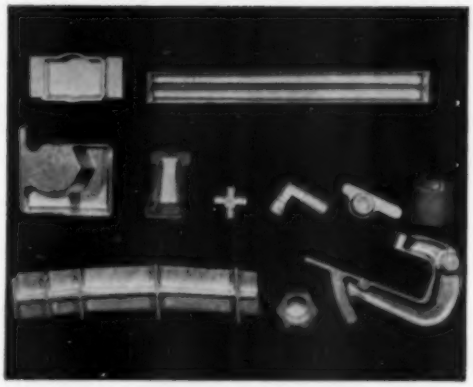
COMMUNICATIONS & ELECTRONICS DIVISION

4501 AUGUSTA BLVD. • CHICAGO, ILL. • Laboratories • Phoenix, Arizona and Riverside, California

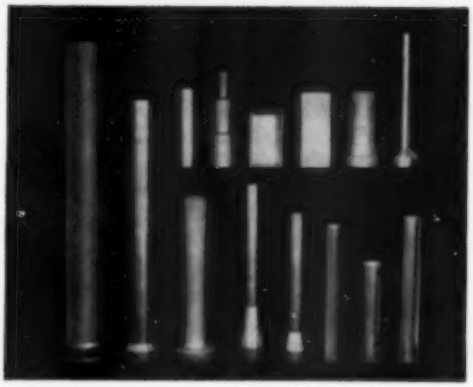
You can make it faster and better with Harvey Aluminum



EXTRUSIONS . . . For decorative as well as basic parts, custom-designed aluminum extrusions replace riveted and welded assemblies . . . simultaneously adds strength, simplifies fabrication.



PRESS FORGINGS . . . Where parts must combine maximum strength with savings in weight, cost and manpower, Harvey aluminum forgings often completely solve the problems encountered by the designer.



IMPACT EXTRUSIONS . . . Thin-walled, tubular structures can be produced by this method and held to very close tolerances. Machining is practically eliminated; scrap is greatly reduced.

STRUCTURALS . . . High strength, light weight, workability, corrosion resistance. Aluminum extrusions combine all four . . . are ideal as basic load-bearing members.

MACHINING STOCK . . . Harvey deep-drawn hex and round stock set a new mark in uniform grain structure—consistent from surface to core. This means fast, chatter-free cutting, long tool life, few rejects and true threads.

FORGING STOCK . . . If you make your own forgings in quantity, Harvey extruded forging stock can save many intermediate steps. Custom-designed extrusions whose cross sections approximate the forged blanks may be cut to length.

EXTRUDED PIPE AND TUBE . . . Seamless . . . uniform in structure, size and shape . . . clean and smooth inside and out . . . easily formed. Usable in applications ranging from portable irrigation systems to aircraft heat exchangers.

DRAWN TUBE . . . Combines strength and high finish . . . ideal for TV antennas, furniture, and similar products. Cold drawn for structural uniformity . . . and the temper is specially controlled for good workability.

SCREW MACHINE PRODUCTS . . . The West's largest installation of multiple-spindle screw machines can reduce your manufacturing costs. Harvey carries your job through from engineering to quality control.

Harvey is a leading independent producer of aluminum extrusions in all alloys and all sizes, special extrusions, press forgings, hollow sections, structurals, rod and bar, forging stock, pipe, tube, impact extrusions, aluminum screw machine products and related products. Also similar products in alloy steel and titanium on application.

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HARVEY Aluminum

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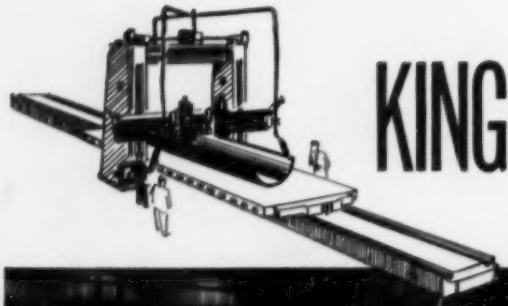
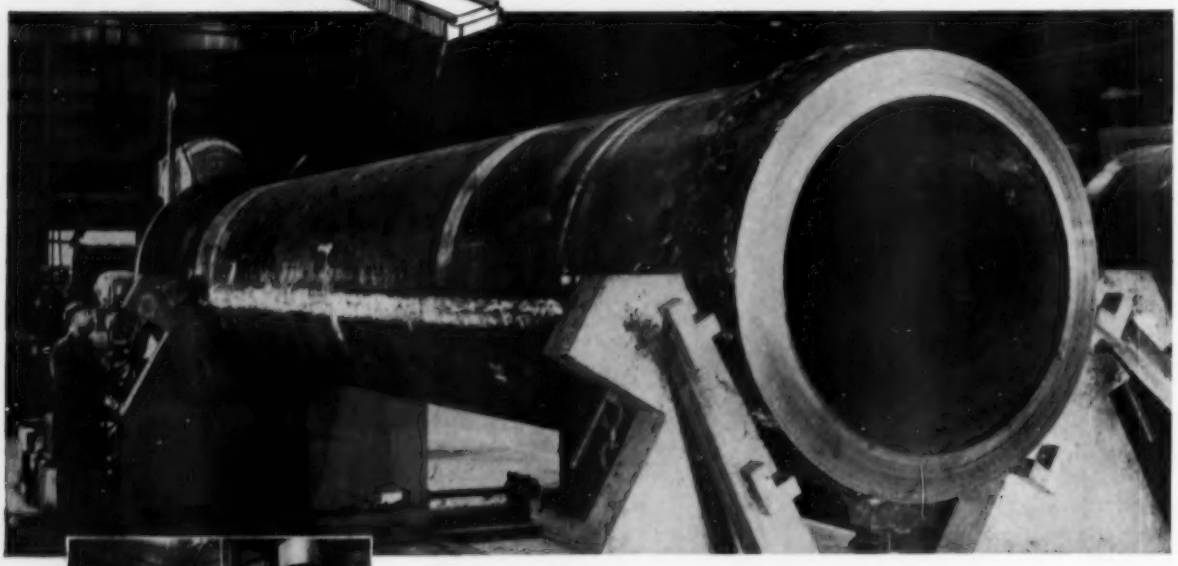
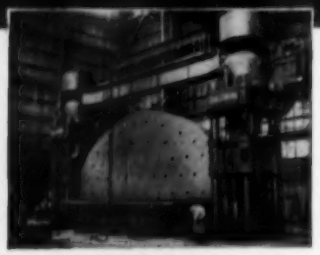
TORRANCE, CALIFORNIA
BRANCH OFFICES IN PRINCIPAL CITIES

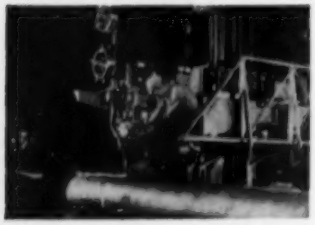


KING SIZE PRESSURE VESSELS

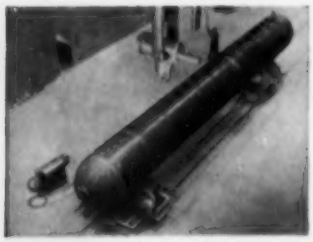




This 8,000 ton hydraulic beam press at Mountaintop can bend steel plate 39 ft long and up to 9 inches thick.



Twin-arc welding units on traveling booms permit welding of vessels up to 8 inches thick, 12 ft in diameter and any desired length.



Two-million-volt X-ray generator penetrates steel up to 12 inches thick — permits rapid inspection of welds for detecting flaws, holes or scale.

. . . demonstrate exceptional capacity of FW fabricating facilities

THE photo above shows a final machining operation on one half of a 48-foot high-pressure vessel fabricated at Foster Wheeler's new Mountaintop, Pa. plant. Another of these solid steel vessels now on order is 36 ft long, 4 ft in diameter, with a wall thickness of *5 inches*. It will be constructed of two half shells, bent on the 8,000 ton beam press from 5-inch steel plate 36 ft long. The two halves will be welded together and machined to form the completed cylinder.

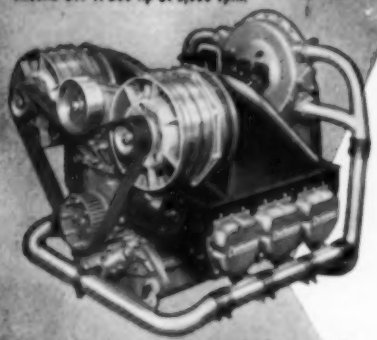
With metal forming, welding and machining facilities of exceptional size and capacity, located in large modern plants at Carteret, N. J., Dansville, N. Y., Mountaintop, Pa. and St. Catharines, Ontario, Foster Wheeler offers a unique fabricating service to industry. High pressure vessels, pressure piping and unusual weldments to Code requirements and beyond, can be produced by the most modern and efficient methods, with substantial savings in time and cost.

Write today for complete information on FW fabricating facilities. We will be glad to quote on your specific requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW HIGH for CONTINENTAL AIRCRAFT POWER

CONTINENTAL MODEL FSO470, fan cooled and supercharged helicopter engine, power plant of the Cessna CH-1. 260 hp at 3,000 rpm.



The exclusive Continental Factory Re-Manufacture Plan saves you money and minimizes dead time. Gives you a power plant in new engine condition—back to zero hours and with factory new engine guarantee—at low fixed cost.

On Sept. 13, 1955, a Cessna CH-1 helicopter settled to a landing on the summit of Pikes Peak, something no aircraft of any type had ever done before. Then, after taking a third passenger aboard, it successfully finished hovering tests begun earlier in the week, including a climb to an indicated altitude of 17,600 feet above Colorado Springs. At Camp Hale, it hovered with 50 gallons of fuel and four persons aboard—a phase of the test considered especially noteworthy, since it took place at a season when all flying operations in the area are normally suspended because of extreme turbulence at this high altitude . . . These latest tests add to the already fine performance record of the fastest certified helicopter in the United States. The characteristics demonstrated in the Colorado workout speak volumes for the power plant, too, and what they say has real meaning for all who own or fly utility planes. They underscore the wisdom, now more apparent than ever, of choosing a plane which gives you dependable Continental power.

•

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HELPS OLD MOTHER HEN GATHER HER CHICKENS

North American FJ-4 Fury Jet

Toss a squadron of planes into the air from a floating carrier base — chase the planes around the vast ocean sky at speeds sometimes faster than sound. While her chickens have scrambled, put old mother hen herself, through violent tactical maneuvers. After an hour or two, bring them all back together again from hundreds of miles apart.

This is routine for the men, planes and ships of the U. S. Navy's "Hunter-Killer" groups. And Cline Electric, a leading manufacturer of shipboard and aircraft controls, and other electrical apparatus, is playing a vital role in helping make it all possible. We're proud of our assignment!

Private industry, too, can depend on Cline as a supplier of efficient electrical equipment.

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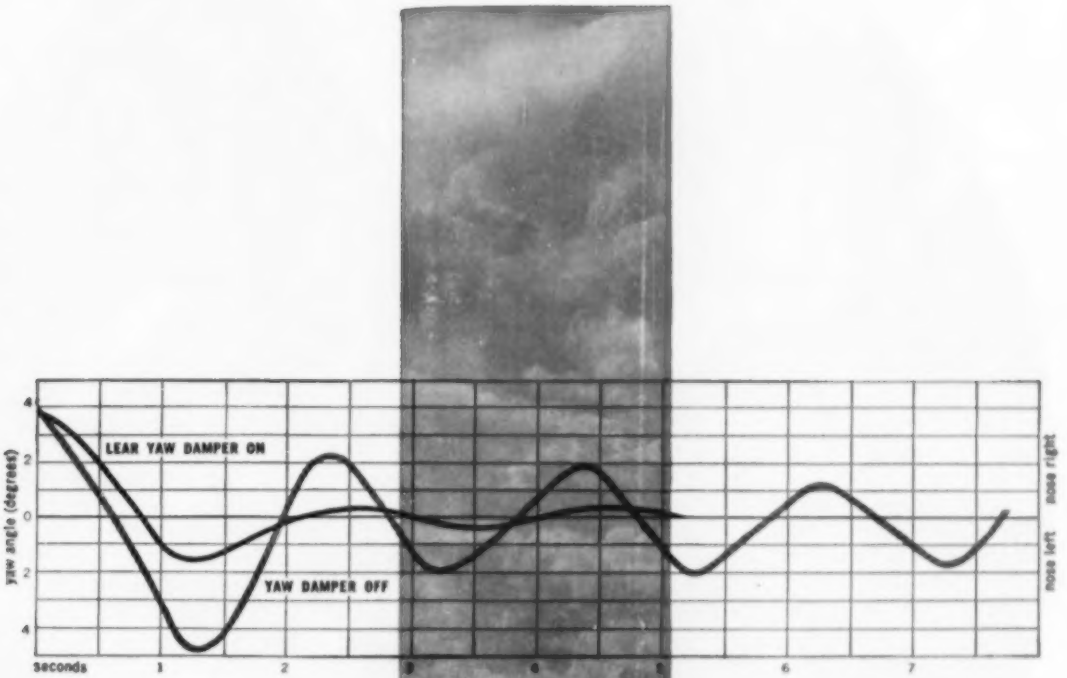
BUILDING PRECISION INTO TARGET ZERO

WIN YOUR WINGS IN THE U. S. NAVY!



The NAA data presented here show the difference in damping time between Lear Yaw Damper "off" and Yaw Damper "on" operation, starting from steady side slips with full rudder, at .9 Mach number, altitude 40,000 feet.

to increase "kill" probability

Weapon system design combines many arts for the purpose of annihilating the enemy. The spectacular stabilizing effect of the Lear Yaw Damper on the flight path of the F-86D Sabre is shown in the above curves prepared by North American Aviation, Inc., for the enlightenment of fighter pilots. "From these data," says NAA, "it is clearly seen why the yaw damper is an essential device to make your airplane a more effective and efficient rocket firing platform."

LEAR *Grand Rapids Division/ Grand Rapids, Michigan*

IP-9

LEAR PITCH, ROLL, AND YAW DAMPERS ARE AVAILABLE IN ELECTRONIC, MAGNETIC, AND TRANSISTORIZED VERSIONS, ENGINEERED TO THE PERFORMANCE OF THE CENTURY SERIES FIGHTERS

which do you want?

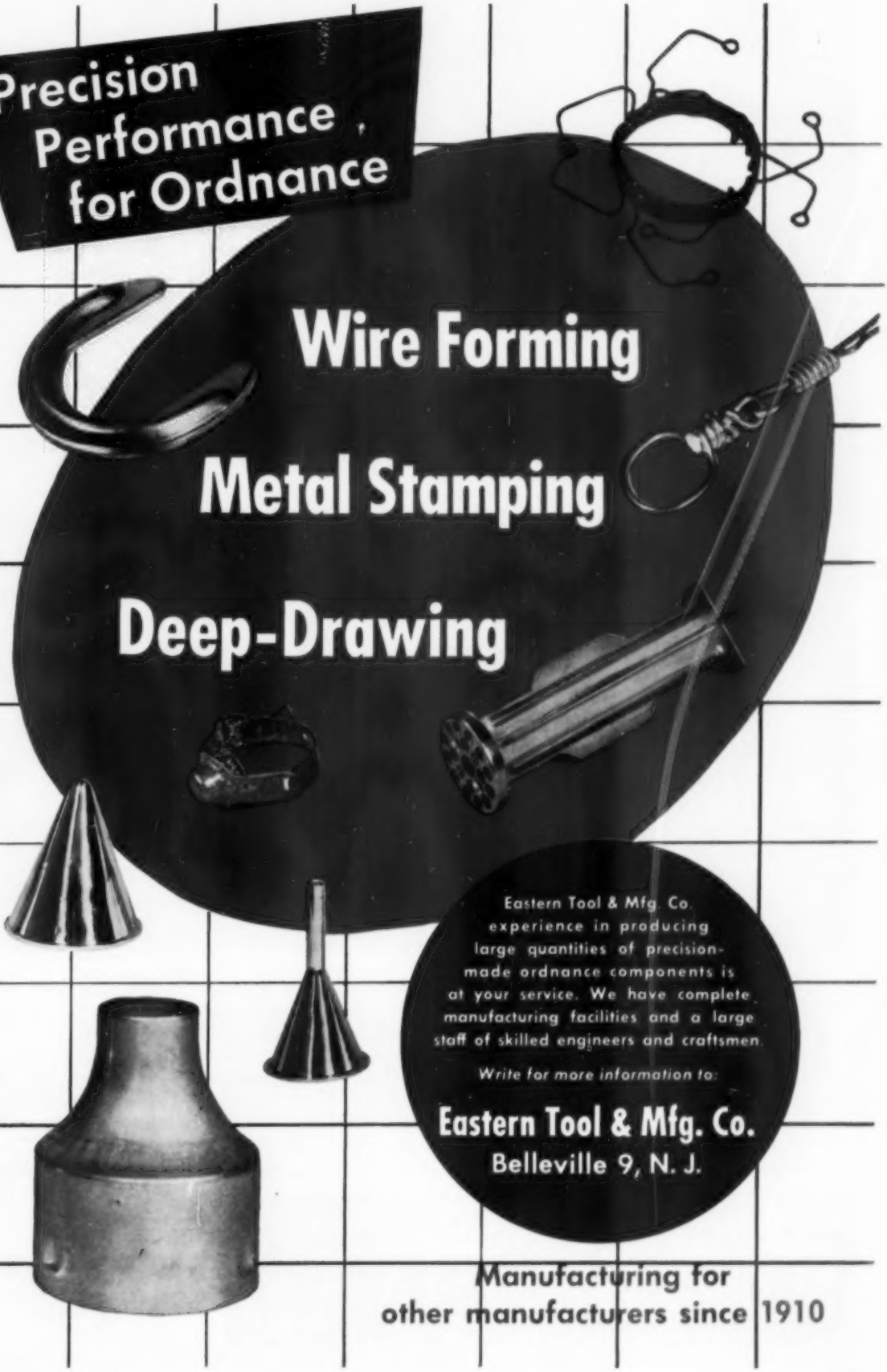
Money or the moon?

It was reaching for the moon which resulted in the development at Martin of one of the most dynamic engineering team operations in the whole new world of flight systems development.

Most of the people on that team are young and moving ahead fast. Do *you* know what's happening at Martin... and what tomorrow may hold for you here in the fields of aircraft, missiles, rocketry, nuclear power and space vehicle development?

MARTIN
BALTIMORE

Precision Performance for Ordnance



Eastern Tool & Mfg. Co. experience in producing large quantities of precision-made ordnance components is at your service. We have complete manufacturing facilities and a large staff of skilled engineers and craftsmen.

Write for more information to:

Eastern Tool & Mfg. Co.
Belleville 9, N. J.

Manufacturing for other manufacturers since 1910

MASS PRODUCTION of projectiles with Verson PRESSES AND TOOLING for greater production and lower costs!

Piercing a steel billet in a 600 ton Verson hydraulic press.

Here a Verson hydraulic push through press sizes the cavity and O.D. of the steel forging.

AMONG the many advancements in the press forming of metals that have been pioneered by Verson in recent years are new, improved presses and tooling for producing artillery projectiles. Under the pressure of a combination military and civilian economy, Verson methods have resulted in substantial savings in metal and have made possible great increases in output without a corresponding increase in critical manpower.

Equally important strides have been made in civilian production, too, but tremendous opportunities for modernization and increased efficiency remain. We would like to have the opportunity to discuss press forming of metals with you and help you set up a plan that will enable you to take advantage of the many cost cutting opportunities that are becoming available.

Write, today, outlining your requirements.

A Verson Press for every job from 60 tons up.

Verson

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do you need help

"R. Hoe & Company would be one of the first to whom we would turn for help." So says Pratt & Whitney, one of thirty-odd leading manufacturers with whom HOE has cooperated in making castings, machine parts, subassemblies and many complete machines.

150 years of manufacturing printing presses, heavy ordnance and components has equipped HOE to do similar work for you.

in producing castings... machine parts... subassemblies or complete machines?

Need precision castings?

A capacity of sixty tons a day plus a skilled staff of engineers and metallurgists is at your command at HOE. We cast them small (just a few pounds) — and we cast them king-size (up to fifteen tons)... in any desired grade of gray iron, semisteel or alloy.

Need tolerances of ±.0005" in heavy machinery?

HOE machine shops are fully equipped — with all tools and facilities required by modern shop practice — and during the next two years HOE will invest $1,200,000 in additional machine tools. Every machine is operated by a machinist accustomed to working to tolerances of ±.0005" in making heavy machinery.

Need assembly capacity?

HOE assembly space is ample for the erection of the largest machines — giant newspaper presses are being completely assembled at the HOE plant.

Write (or telephone CYpress 2-2400) for further information. A HOE representative will be glad to call and discuss your specific requirements in detail. No obligation, of course.

PRATT & WHITNEY
DIVISION NILES-BEMENT-POND COMPANY
WEST HARTFORD 1, CONNECTICUT

October 4, 1955.

R. Hoe & Company Inc.
910 East 138th Street
New York 54, N. Y.

Gentlemen:

During World War II and the Korean Engagement, the critical demand for Machine Tools made it imperative for us to utilize the facilities of manufacturers of lower priority equipment.

During both these periods Pratt & Whitney Company was fortunate in obtaining the aid of many of the best qualified builders of printing presses, textile machinery and special machinery in the United States.

The amount of work subcontracted to R. Hoe & Company during both periods was limited only by the available capacity as compared to delivery requirements. Several thousand machines were fabricated, assembled, tested and shipped direct to the customer from the R. Hoe & Company plant.

Quality of workmanship was excellent. Maintenance of delivery dates was among the best.

Should another national emergency arise, R. Hoe & Company would be one of the first to whom we would turn for help.

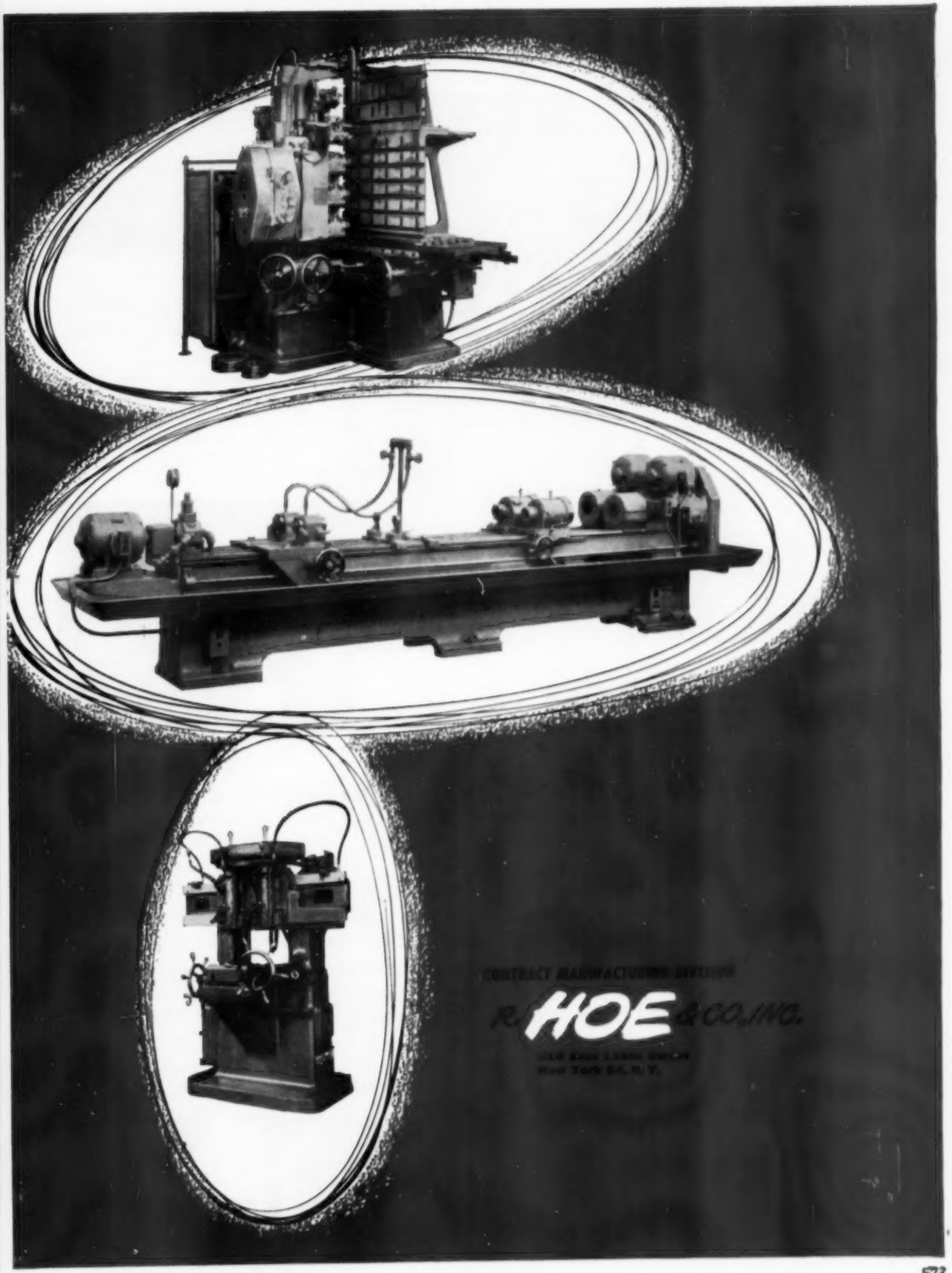
Very truly yours,

PRATT & WHITNEY COMPANY, INC.

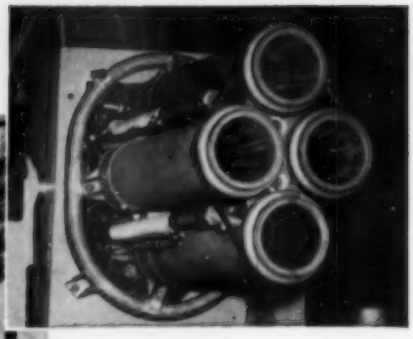
A. L. Kna
Vice-President & Manager
Machinery Division

N.

MACHINE TOOLS : SMALL TOOLS : GAGES


CONTRACT MANUFACTURING DIVISION
R. HOE & CO., INC.

new team impetus...



In the field of fuels research, Olin Mathieson and Reaction Motors are developing new liquid and solid propellants as well as additives to improve current propellants. Reaction Motors and Marquardt Aircraft establish specifications for these new rocket and ramjet fuels and test and evaluate their capabilities for meeting tomorrow's needs.

developing super fuels for supersonic propulsion

Applying the modern "weapons system" concept to the problems of supersonic propulsion, Olin Mathieson, Reaction Motors, and Marquardt Aircraft are combining their unique skills and experience in the development and production of rockets, ramjets, and special fuels. Coordinated by the OMAR Joint Technical Committee comprised of representatives of the three companies, this applied research program is dedicated to the practical advancement of supersonic aircraft and missile propulsion.

3519

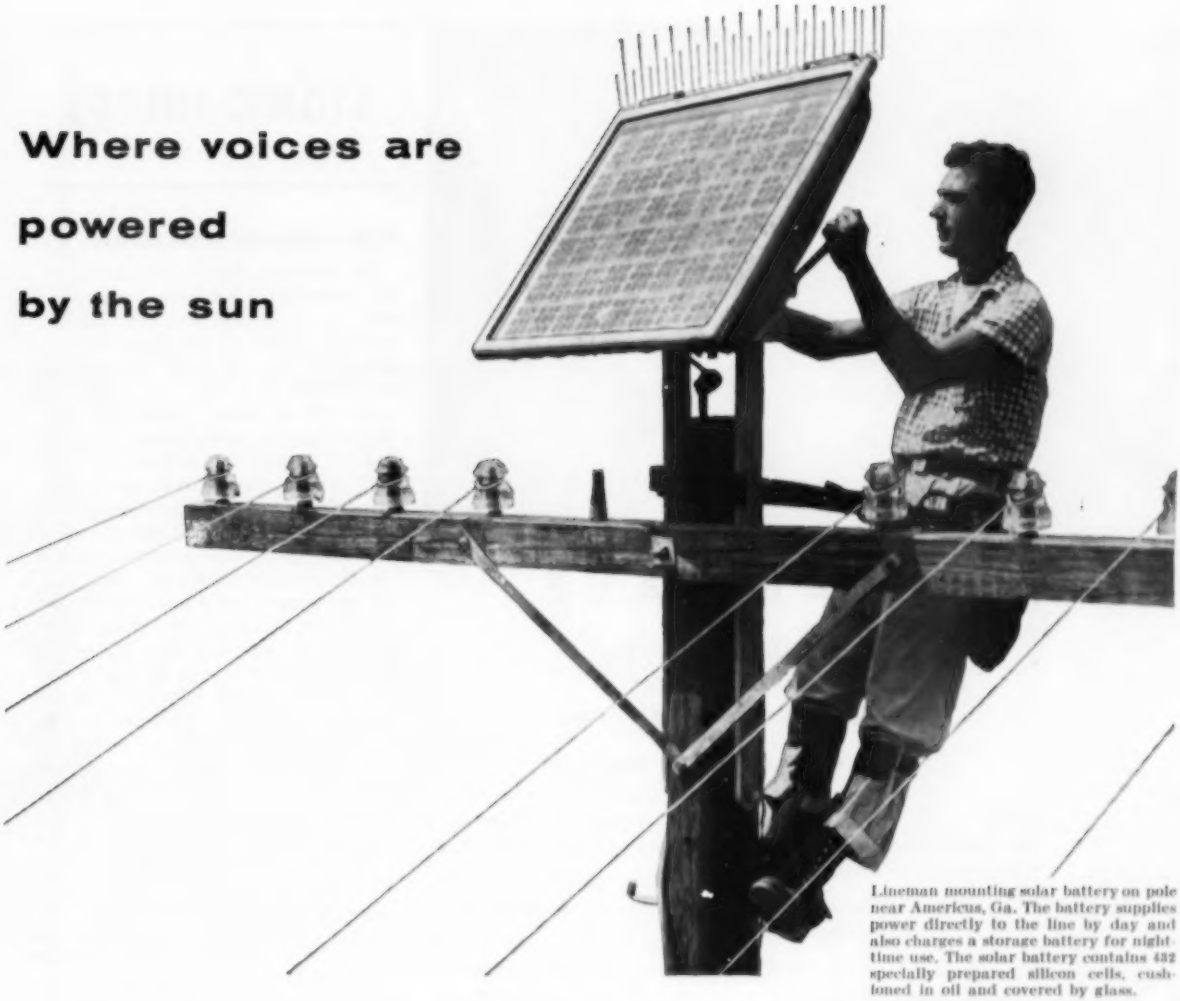
Marquardt Aircraft Company

Olin Mathieson Chemical Corporation

Reaction Motors, Inc.

MARQUARDT AIRCRAFT
OLIN MATHIESON CHEMICAL
REACTION MOTORS

Where voices are powered by the sun



Lineman mounting solar battery on pole near Americus, Ga. The battery supplies power directly to the line by day and also charges a storage battery for night time use. The solar battery contains 432 specially prepared silicon cells, cushioned in oil and covered by glass.

A new kind of telephone system developed by Bell Telephone Laboratories for rural areas is being operated experimentally by electric current derived from sunlight. Electric current is generated as sunlight falls on the Bell Solar Battery, which a lineman is seen adjusting in position.

The exciting achievement is made possible by two Laboratories inventions—the solar battery and the transistor. The new system uses transistors to the complete exclusion of electron tubes. Transistors require little power and this power can be easily supplied by the solar battery.

Compact and economical, the transistorized system can carry several voices simultaneously without interference. It has proved its ruggedness by standing up to heat, cold, rain and lightning. It promises more and improved telephone service for rural areas and it typifies the Laboratories' continuing efforts to make American telephony still better each year.

In sending and receiving terminals, transistors are used as oscillators, amplifiers and regulators, and for signaling.

One of the transistors (actual size) used in the new system. New ideas, new tools, new equipment and new methods had to be developed for this project.

BELL TELEPHONE LABORATORIES

IMPROVING AMERICA'S TELEPHONE SERVICE PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

YOU CAN SAVE

by packaging SMALL parts as well as LARGER items for both military and domestic uses

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No. 1—The container in the background is a 3-piece metal end telescope for packaging an assortment of items such as bushings, collets, shafts, rods, etc.

No. 2—A 3-piece curled and disced container for the packaging of hearing aid batteries.

No. 3—A plain fibre can used in the packaging of a small roller bearing with the part number embossed in the top cap.

No. 4—A 2-piece curled and disced telescope container for the packaging of taps, reamers and drills. This container can be used to package products of various lengths having the same diameter, by extending the container to the required length.

FOR FURTHER PROTECTION, these containers can be lined with special barrier papers or films. Outer decorative and printed papers also may be applied for identification.

WRITE for complete packaging folder.

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ATOMIC ENERGY

NEW ATOMIC PARTICLE

The discovery of a new atomic particle, the antiproton, which may inaugurate a new era of nuclear research, was announced recently by the Radiation Laboratory of the University of California and the Atomic Energy Commission. The antiproton (sometimes called the negative proton) a nuclear ghost which has haunted the world's physicists for a generation, was created from energy generated in the great Berkeley bevatron, the most powerful atom smasher in the world.

Identification of the particle in one of the classical experiments of nuclear physics was achieved by a team of Radiation Laboratory physicists—Drs. Owen Chamberlain, Emilio Segre, Clyde Wiegand, and Thomas Ypsilantis—with the help of Herbert Steiner and Dr. Edward J. Lofgren, physicist in charge of the bevatron.

Discovery of the antiproton fulfills one of the important purposes for which the AEC spent some $9,500,000 in bevatron construction costs plus annual research budgets. The antiproton is a heavy particle of the same mass but of opposite charge from the proton, which is one of the fundamental particles found in all atomic nuclei. The existence of antiprotons has been a basic tenet of generally accepted atomic theory for a quarter of a century. Despite continuing experiments with cosmic rays, however, the particle had not been detected.

The discovery does not modify the model of the atomic nucleus, according to the discoverers. Rather it reënforces and solidifies current theory. This elimination of uncertainty about one of the cornerstones of nuclear theory is one of the discovery's most valuable features.

Efforts to devise theories to "get along" without the antiproton had been made. With such question now erased, the antiproton may provide a wedge for a deeper probe of the nucleus.

The antiproton does not exist in the atomic nucleus, which is composed of only protons and neutrons. Antiprotons are born and "live" only outside the nucleus following some high-energy nuclear event similar to the collision resulting from bevatron bombardment. The main reason antiprotons have not been discovered before is that they occur only at high energy.

The reaction is as follows: protons are accelerated in the bevatron to 6.2 billion electron volts. These particles are directed at a target of copper inside the

To see defense jobs through from scratch

The abilities and facilities to take charge from inception to completion—from research through development, engineering and tooling, production, testing, field service and training—qualify Burroughs to assume the complete responsibility for fulfillment of complex defense assignments.

This coordination enables Burroughs to handle, from start to finish, the most important defense projects in the exacting fields of instrumentation, control systems, communications, electronic computation and data processing.

This coordination, too, underlines Burroughs' ability as a prime contractor for assignments of a highly classified nature. Inquiries welcomed. Burroughs Corporation, Detroit 32, Michigan.

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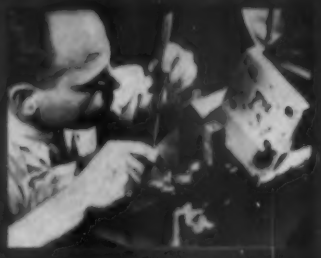
2. DEVELOPMENT



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6. FIELD SERVICE & TRAINING

Burroughs

BURROUGHS INTEGRATED DEFENSE FACILITIES INCLUDE:
Burroughs Corporation plants in Detroit and Plymouth, Michigan
Burroughs Electronic Instruments Division, Philadelphia, Pa.
Haydu Brothers of New Jersey, Plainfield, New Jersey
Control Instrument Company, Brooklyn, New York
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Looking to future expansion, Burroughs invites inquiries from qualified engineers.

0 TO 300 G'S

IN JUST 150 MILLISECONDS!

With Hycon's new "Vari-G" Centrifuge, you can test ordnance fuses, electronic components, flight instruments, and control units... subject them to service operating conditions, meeting virtually all demand curves, without actual firing or launching. Easily changed programming cams simulate any acceleration-time function, and accelerations as high as 300 G's can be produced on two one lb. test specimens, in 150 milliseconds or less. Specimens up to 10 lbs. and reaching accelerations of 100 G's can also be tested. A complete packaged system, ready-to-run, the "Vari-G" has its own control unit, power supply and recorder... **plus** accuracy, safety features and operating simplicity never before offered in a standard, commercial unit.

TYPICAL SPECIFICATIONS*

RATE OF CHANGE ... 0 to 300 G's in 150 milliseconds (max.)

ACCURACY ... 5% duplication of nominal demand curve as determined by programming cam

REPEATABILITY ... 2.5% of actual demand curve

WEIGHT, SIZE LIMITS ... tests two 1 lb. units simultaneously, test units up to 10 pounds, 100 G's, and 125 cubic inches or smaller

CONNECTIONS ... 18 slip rings for input or output

POWER REQUIREMENT ... 110 v, 60 cycles, single phase, 1.5 kva

220 v, 60 cycles, three phase, 6.6 kva

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bevatron chamber. When the proton crashes into a neutron in one of the copper atoms the following come out of the collision: the two original particles (the proton projectile and the struck neutron), and a brand new set of heavy particles—a proton and an antiproton.

In the collision a part of the bombarding proton energy is converted into mass according to Einstein's theory. The particles are expected to be found in cosmic rays but in low abundance.

THERMONUCLEAR PROGRAM

The Atomic Energy Commission is carrying on a major research effort in controlled thermonuclear reactions at Princeton University and at AEC laboratories operated by the University of California at Los Alamos, N. Mex., and Livermore, Calif. In addition, there are projects at Oak Ridge, Tenn., and New York University. The over-all research program is known as Project Sherwood.

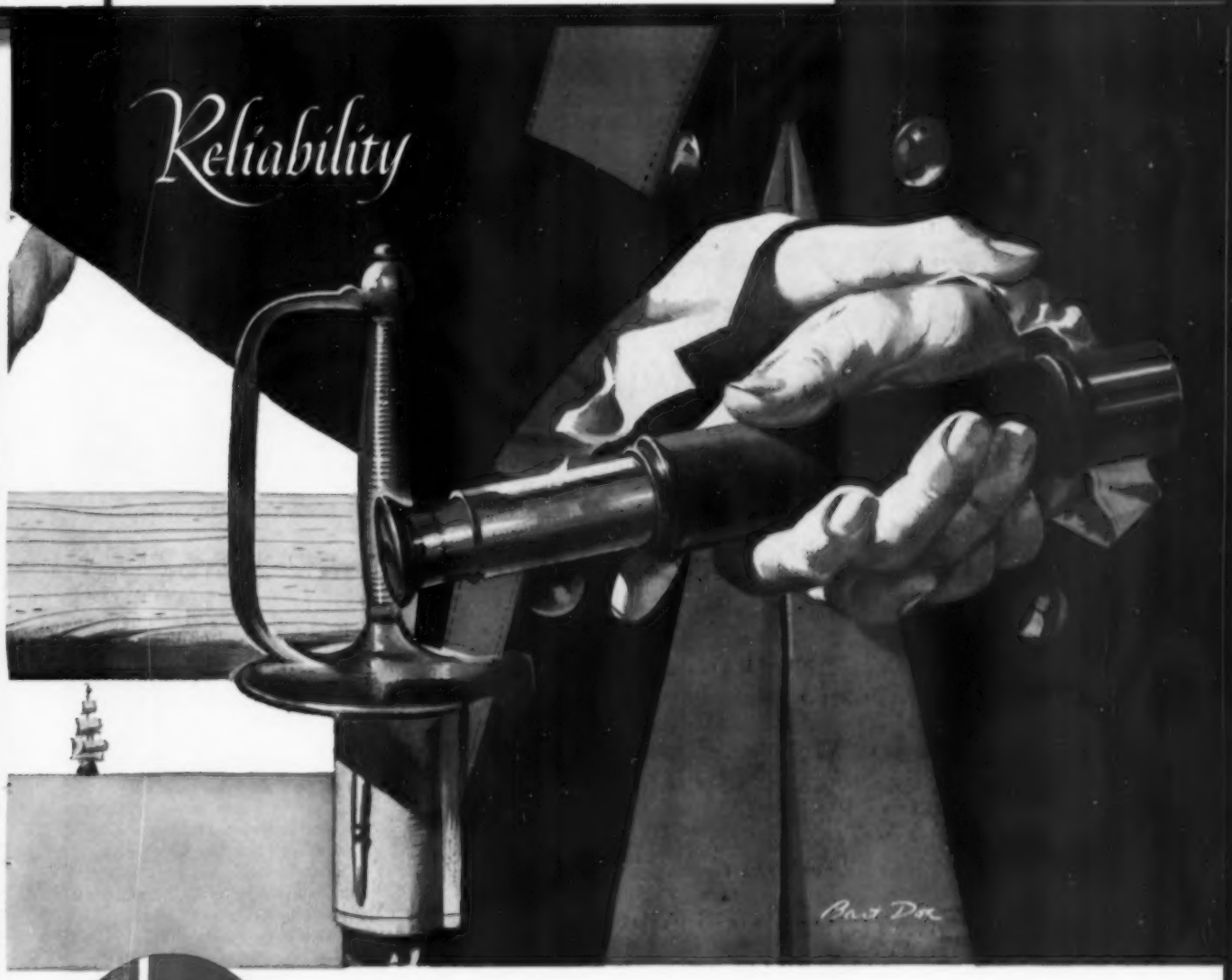
This long-range program has been under way for several years and is directed toward the possibility of controlling the release of great amounts of energy from reactions involving the fusion of light nuclei.

This process of energy release is believed to be similar to that which constitutes the source of the sun's energy. The controlled release of this energy may offer significant potentialities for peacetime application, and the present research program within the AEC was instituted in the hope of developing these potentialities.

In essence, the problem is that of heating an appropriate nuclear material (such as deuterium) to temperatures of several hundred million degrees and of confining it somehow at that temperature for a sufficiently long period of time to allow an appreciable portion of the nuclei to fuse together with consequent release of energy in the form of energetic neutrons and charged particles. This process could constitute a great new source of energy.

According to Professor Lyman Spitzer, Jr., of Princeton University, by far the greatest reserve of stored energy on earth is locked up in the nuclei of the hydrogen atoms present in the oceans. Deep inside the sun and the stars hydrogen nuclei combine to form helium nuclei, releasing vast energies. This combination, or fusion, of light nuclei is called "thermonuclear burning." The titanic energies released by thermonuclear burning have been unleashed in the hydrogen bomb.

Thermonuclear burning occurs most readily with deuterium, a heavy isotope of hydrogen. Although only one deuterium nucleus is present in water for every 6,400 nuclei of ordinary hydrogen, the total amount of deuterium available in the oceans is enormous. If the energy stored in these nuclei could be released in a



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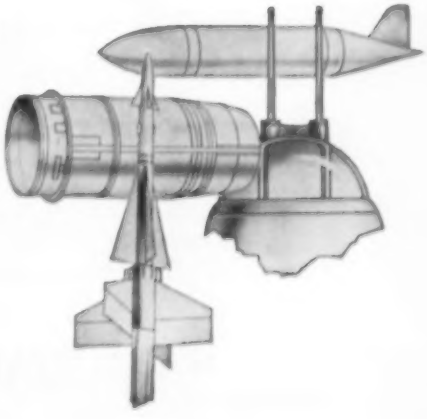
Just as success sailed with John Paul Jones on the thundering, blood-soaked decks of *The Ranger* and *The Bon Homme Richard*, so in every major conflict to this day has victory crowned the valor of our fighting men.

Reliability in men and machines was, and is, the security of our nation.

At Rheem, we, too, are proud of the reliability of our men and machines and the enviable record of low per-unit cost and on-time completion schedules amassed in our role as prime contractor to the United States Government and sub-contractor to other industry leaders.

The Government Products Division facilities of Rheem are presently in quality development and production on air frames, missile and jet-engine components, airborne ordnance, electronics and ordnance materiel.



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RESEARCH *and* DEVELOPMENT
in EXPLOSIVES *and* AMMUNITION

Our technical staff of qualified personnel, using our extensive laboratory, pilot plant, and range facilities, has demonstrated its ability to work in close coordination with others. We are prepared to take on new problems and matters of practical application at any point in the scope of usefulness of explosives and ammunition—*for industrial as well as defense purposes.*

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The Technical Division of
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is currently engaged in

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- Effect of altitude on performance of explosives, propellants, tracers, and incendiary elements
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- Rocket-motor-igniter development
- Tracer development
- Design of electric detonators and squibs
- Measurement of high-explosive blast-parameters
- Incendiary ammunition
- Surveillance testing of explosives and ammunition
- Calorimetry of explosives and propellants
- Development of explosive destructors
- Mil Standard testing of ordnance items for various contractors
- Fragmentation studies

NATIONAL NORTHERN
Technical Division National Fireworks Ordnance Corp.
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controlled manner and used for generation of electrical power, a virtually inexhaustible supply of power would be available to mankind. Conservatively estimated, the deuterium in the ocean's waters is sufficient to provide many times the present rate of world energy consumption for more than a billion years.

INDUSTRIAL PRODUCTION

The Atomic Energy Commission is soliciting proposals for the production of refined uranium salts in privately owned and operated facilities. This action represents another step in the Commission's efforts to expand the scope of private participation in the uranium industry.

The process steps employed in the atomic-energy program to convert the uranium content of ores to the desired form consist of mining and milling of ores to produce a concentrate, refining the concentrate to produce a purified salt, conversion of the salt to metal or UF_6, and, in the case of metal, fabrication into suitable shapes. At the present time the extent of participation by private industry in these activities is limited to the mining and milling steps.

Specifically, the Commission is interested in receiving proposals from qualified firms to process, over a 5-year period, uranium ores or concentrates to either uranium tetrafluoride, or uranium hexafluoride, with deliveries to begin about July 1958. The Commission will consider proposals for any production rate up to a maximum of 5,000 tons U_3O_8 equivalent per year.

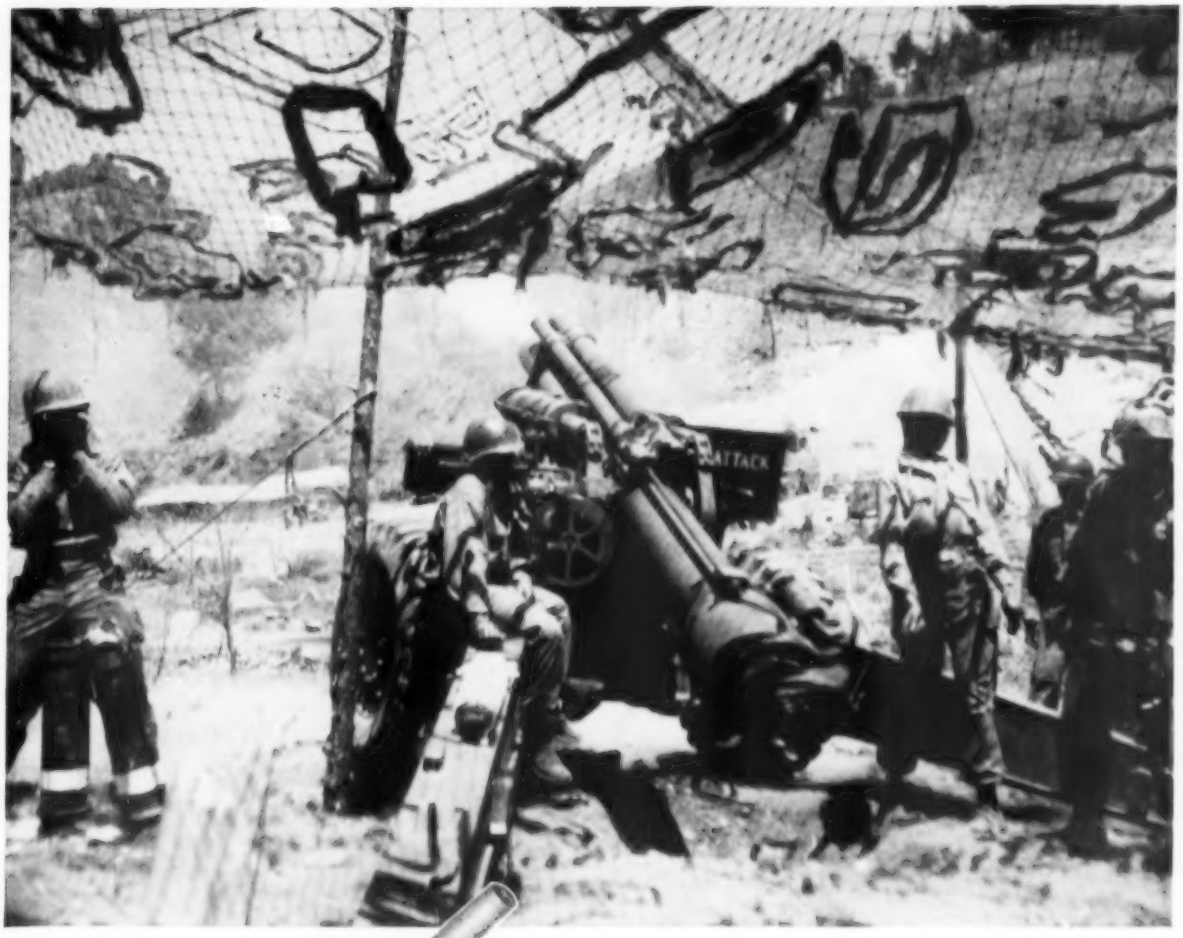
Proposals may be based on arrangements whereby the U_3O_8 concentrates are supplied by the Commission and refined salts returned, or, alternatively, the Commission will consider proposals for direct purchase of the refined salts from a company having or obtaining its own supply of uranium ores or concentrates.

To assist in the preparation of proposals the Commission will make available classified technology relating to refining of uranium salts to those applicants eligible to receive classified data under the Access Permit procedure.

RADIATION TEST CELL

A new chamber for the study of atomic radiation is now being constructed for the Air Research and Development Command at Dayton, Ohio. The new facility—called a radiological hot cell—will have two main uses. It will be used by Wright Air Development Center engineers to study materials or equipment that have been placed in an atomic reactor and are themselves radioactive, and it will also enable them to subject materials or equipment to radiation. This will be the only Air Force facility for all types of work on radioactive materials—such as radiochemistry, and irradiation with cobalt 60.

THE POWER TO PRODUCE



Ordnance inspection of the 155 mm howitzer gun carriage at Oliver's South Bend Plant No. 2.

Gun carriages, for instance!

It's the 155 mm howitzer. Gun carriages for this famous field piece have been a continuing assignment—just one among scores of products, assemblies and parts produced by Oliver for national defense. Others range from castings to conveyors, from fans to fuselages. Oliver's ten plants, strategically located, offer the diversified facilities and integrated operations to produce fast and economically. And at highest quality standards. Here, management is alert to your needs. Designers, engineers and production executives are ready to meet each new problem with the experience that makes sure of results. Write for complete information.

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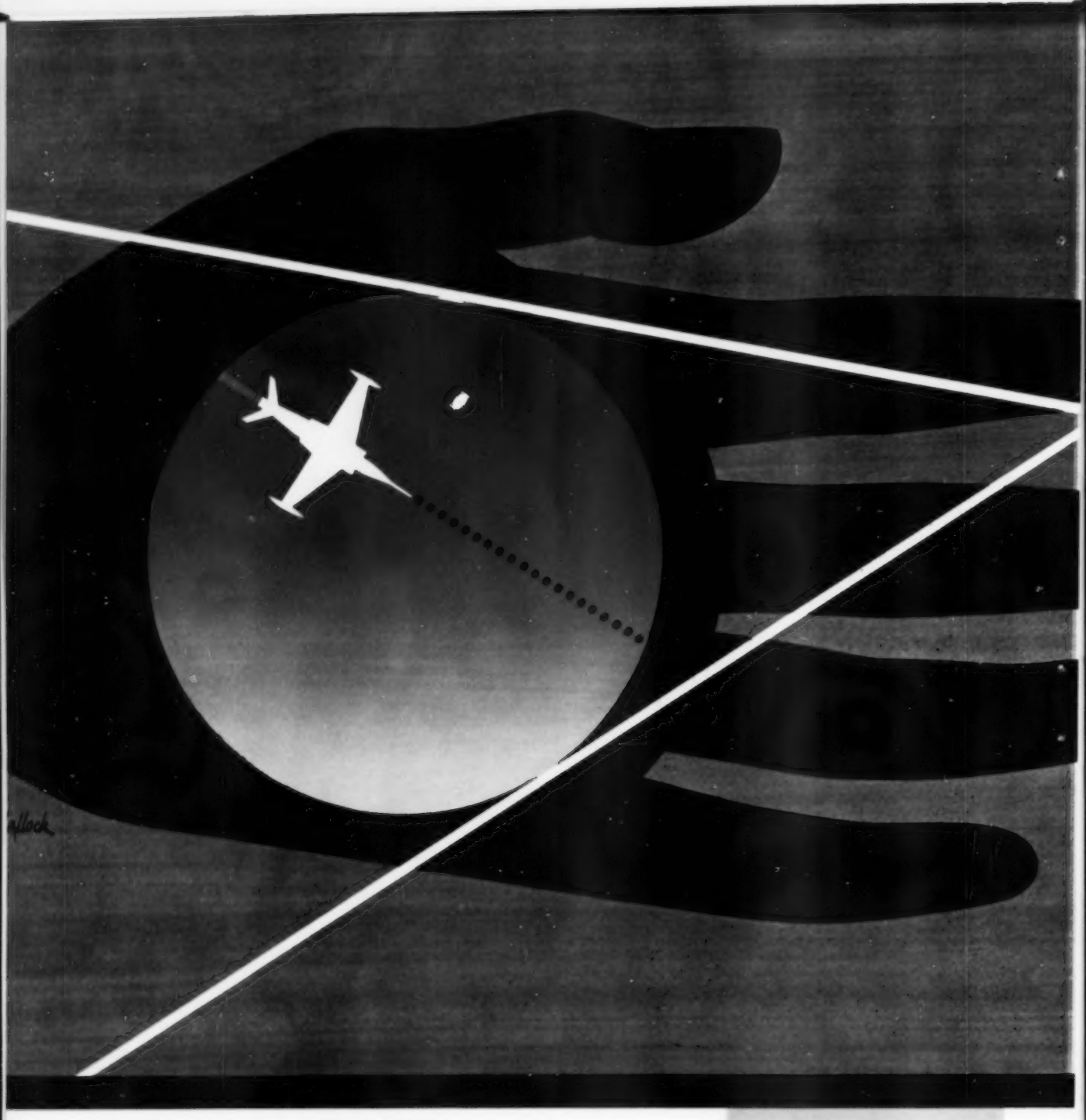

ENGINEERS WANTED: For top-flight men, Crosley offers unusual opportunities to explore new scientific frontiers that lead to outstanding and rewarding careers. Write to Personnel Director, Crosley Government Products, Cincinnati 15, Ohio.

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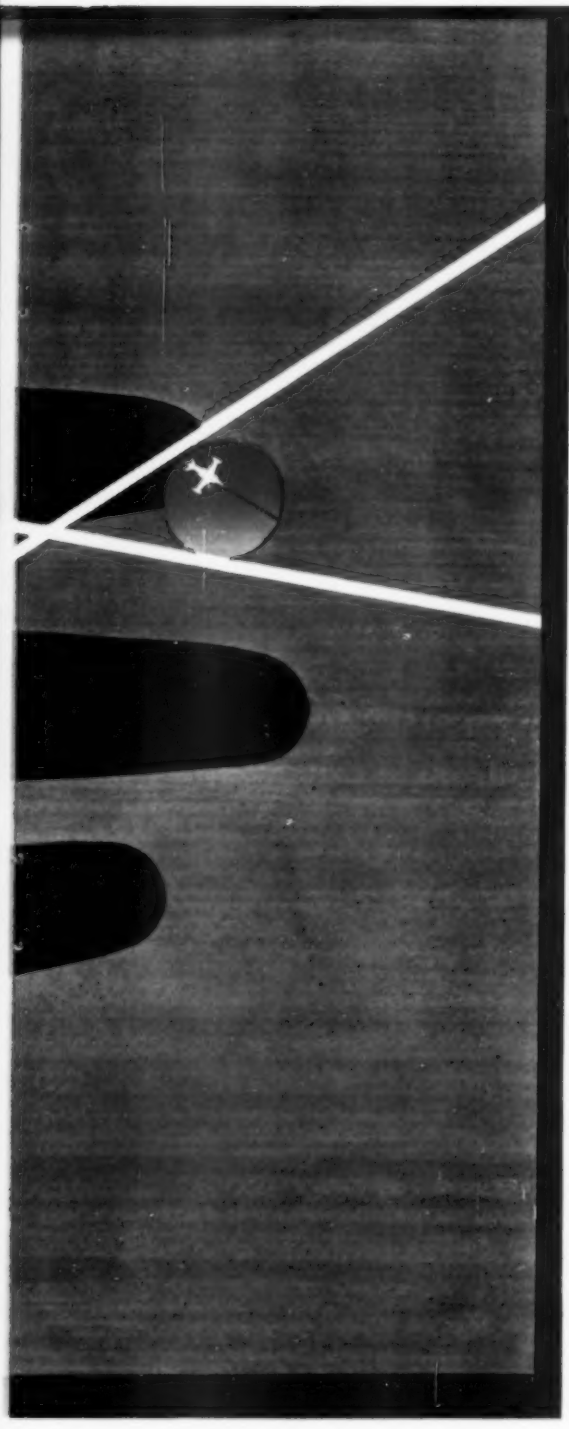


From Crosley— new dimensions for the electronic age

As electronics works its magic for defense and industry, scientists of Avco's Crosley Division reckon with the problem of making already reliable electronic systems more flexible—to give them greater usefulness in navigation, communication, national defense. Now, out of intensive study of electronics and related areas—thermodynamics, optics, aerodynamics, human factors—has emerged the knowledge necessary to achieve this critical goal. Working closely with the military, outstanding Crosley scientists have changed the dimensions of many electronic systems: lightening them, compressing them, "miniaturizing" them. Now—improved radar, communications receivers, navigational aids, and scores of other systems are coming off the Crosley lines and performing their miracles in smaller space, with less weight, requiring less power. Through "miniaturization" in electronics, as well as advances in air-frame assemblies, Crosley brings the findings of research to practical fulfillment—for defense, for peace.

If your plans are linked to advanced electronics, find out how Crosley's capabilities and knowledge can be brought to bear on your specific problems. Wire, phone or write for Miniaturization Booklet to Avco Defense and Industrial Products, Stratford, Conn.

FOR A COPY OF THIS HALLOCK ILLUSTRATION, SUITABLE FOR FRAMING, WRITE TO PUBLIC RELATIONS DEPT., AVCO DEFENSE AND INDUSTRIAL PRODUCTS, STRATFORD, CONN.

avco defense and industrial products

MANUFACTURING CORPORATION

Avco Defense and Industrial Products combine the scientific skills, and production facilities of 3 great divisions: Crosley; Avco Advanced Development; Lycoming—to produce power plants, electronics, air-frame components, precision parts at: Boston; Cincinnati; Dayton; Everett, Mass.; Los Angeles; Nashville, Tenn.; Stratford, Conn.; Washington, D. C.; Williamsport, Pa.

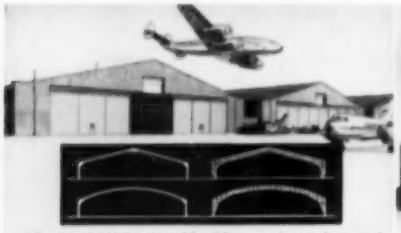
TODAY'S MILITARY SERVICES, WITH THEIR TREMENDOUS TECHNOLOGICAL ADVANCES MADE POSSIBLE THROUGH SCIENCE, OFFER A VITAL REWARDING CAREER

LURIA STANDARDIZATION PROVIDES THE FAST, EASY, ECONOMICAL SOLUTION TO AIRPORT EXPANSION

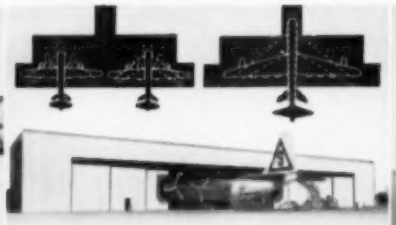
Why do Luria steel structures fill the widest variety of airport needs? Because the Luria System of Standardization provides the *adaptability, flexibility*—yes, and even the *permanence*—that formerly could be found only in *custom-built* units. *And this is achieved without sacrificing the speed and economies of standardization.*

During the last ten years, nearly 500 Luria aircraft installations have been made. The United States Air Force has standardized on 14 Luria designs . . . and uses a wide variety of other Luria hangars. At Lockheed Aircraft, Luria structures cover over a million square feet. Among the hundreds of other Luria installations are hangars and buildings for the airfields of Turkey, Iran and Argentina . . . for many air lines including Pan American, United, American, Eastern, Northwest and Capital . . . and for many airports including New York International, Detroit Wayne Major, Springfield, Illinois and Westchester County, New York.

A PARTIAL SHOWING OF STRUCTURES FOR EVERY TYPE OF MILITARY AND COMMERCIAL AVIATION

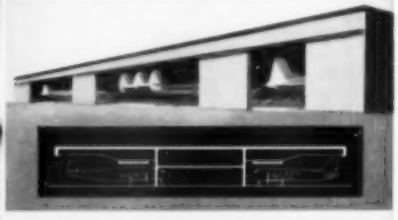


STANDARDIZED HANGARS — both girder and truss types for commercial and military aircraft.



ALL-PURPOSE "WING" HANGAR accommodates one heavy aircraft or two medium aircraft.

DOUBLE CANTILEVER hangar for double-apron air traffic. Accommodates aircraft of all sizes.



AIRPORT TERMINAL shows how effectively Luria steel buildings can be adapted to airport needs.

STANDARDIZED MAINTENANCE SHELTER for heavy aircraft. Portable, enclosed, weather-proof.

- ☑ PERMANENT CONSTRUCTION
- ☑ MAXIMUM FLEXIBILITY
- ☑ HIGH SPEED ERECTION
- ☑ LOW COST MAINTENANCE
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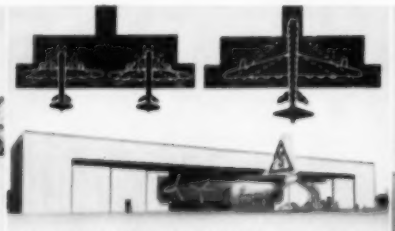

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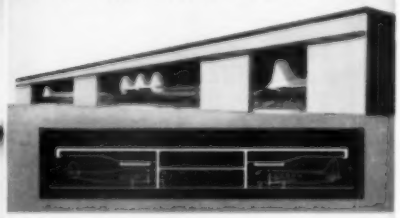

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Secretary of the Army

The Army's Weapons

New and powerful ordnance has been added to the ground forces' arsenal, but the tried and proved weapons will not be dispensed with nor will research be tailored to meet changing pressures

Hon. Wilber M. Brucker

Secretary of the Army

This is an address given recently by Secretary Brucker before the Washington Post of the American Ordnance Association, Washington, D. C.

THIRTY-SIX years ago, when the American Ordnance Association came into being, the first World War was just over. About that time I was hanging up my uniform after slogging through the war in the Infantry. Peace was sweet. We can look back and remember how we hoped it might last forever. Our eyes could not pierce the veil of the future and see that within only a little more than two decades millions of men all over the world would be locked in an even greater conflict.

We were not ready to fight the second great war. We were not ready to fight in Korea when Communism later challenged the free world with armed might. Perhaps if we had been, these struggles might have been averted. Surely the price of victory would have been far less. But they must have taught us a lesson. I think we as a Nation have at last taken to heart the truth pronounced by George Washington which fell so long on deaf ears—that preparedness for war is the soundest basis for peace.

FROM its inception, the American Ordnance Association has been a most determined and articulate exponent of that philosophy. And it has played a very important rôle in fostering the splendid partnership between industry and our armed forces which has provided our fighting men with the tools of victory when the chips were down.

Today, as we seek to exploit to the full the phenomenal technological progress of recent years, this coöperation is more vital to our security than ever before because we simply cannot afford to take the least chance of coming out second best to any nation in the development of new weapons. Therefore the rôle of this Association takes on constantly increasing significance.

A millennium of scientific achievement has been compressed into a comparatively short span. When the Ordnance Association was founded in 1919, the Army was concerned with the improvement of such military novelties of World War I as tanks, motorized artillery, sound ranging systems, high-explosive demolition bombs, and trench mortars. Now it is bending every effort to develop the vast potential of atomic energy and guided missiles.

This contrast between the horizons of our thinking represents amazing progress, but we must not lose our perspective. We must not forget that the purpose of our research and development has not changed—nor will it change. Our objective is to keep our Army adequately supplied with the best possible weapons for the accomplishment of its mission—the best that our scientific genius can devise and our industrial ingenuity can produce.

It is essential to remember that "best" is not an absolute term, connoting a single best weapon or family of weapons exclusively capable of serving all purposes. The best available tool for one job may be entirely useless for another. A pile driver is just right for driving piles but is hardly the tool for nailing clapboards on a house.

The Army's arsenal must be stocked with a well-balanced variety of weapons, each fully adapted to a particular function and each the best of its kind that modern technology can provide.

The Army Ordnance Corps, which shoulders the responsibility for producing these weapons, is a key member of the Army team. Some measure of that responsibility can be clearly shown by what has transpired in the past five years. During this period nearly $35 billion worth of actual deliveries were received by the Army's supply system. It is interesting to note that about 60 per cent of this total, or approximately $21 billion worth, consisted of ordnance material.

IN addition to actual procurement and production operations, the Army Ordnance Corps is interested and has definite responsibilities in the fields of research and development. It is upon the effectiveness of Army Ordnance Corps operations in these areas that the Army depends for continued superiority of weapons and equipment.

Tangible evidence of our success is apparent by the large number of new

weapons made available since World War II. We of the Army recognize that these accomplishments would not have been possible, however, without the wholehearted support and "know-how" of American industry.

The contributions of the American Ordnance Association in the field of production, especially the specialized assistance rendered to the Army through its Technical Committees, has been extremely valuable in helping to keep our troops supplied with the most modern arms.

During the Korean war, for example, the delivery of 3.5-inch bazooka rockets was greatly expedited by production design changes worked out by Association members. New manufacturing techniques were devised which made the quantity production of steel cartridge cases feasible. Suggested design changes increased both the accuracy and the ease of production of rockets and artillery shells. The list is long and impressive.

It is not surprising that the "big" weapons—the sensational applications of radical new concepts, of new materials, and of new sources of energy which make possible almost unbelievable extension of the power of our fighting men—should attract the primary attention of the American public. It is hard for me to avoid reaching for superlatives to describe them.

TAKE the Army's Nike, for example, the first combat-ready, surface-to-air missile system for our air defense. That is truly a wonder weapon—deadly accurate, capable of tracking down and destroying any combat aircraft. Ringing our principal cities and great industrial areas, Nike batteries stand unremitting guard and afford a measure of protection against attack which no other weapon can approach.

Then there is the Army's Corporal, the first operating, supersonic, fully guided, surface-to-surface missile. The Corporal can deliver an atomic warhead on tactical targets far beyond the normal range of artillery—even beyond that of our 280-mm. atomic cannon, an excellent superweapon itself. The Corporal gives a ground commander firepower undreamed of in the past to wreak destruction upon the forces of an enemy deep within hostile territory.

The Honest John is another great military tool available today—a long-range artillery rocket for the close-in support of our troops. It is highly accurate and very powerful. One round has the demolition effect of hundreds of artillery shells.

Recently, when I visited Fort Bliss, Tex., and White Sands Proving Ground, N. Mex., I saw for myself what these weapons can do, and I was deeply impressed. I came back to Washington with a new appreciation of the progress being made by the Army-industry-science team in relating to specific military problems the results of all the exploration, experiment, and imaginative thinking which characterizes this age of spectacular technological advancement in so many fields.

Good as these weapons are, however, and well adapted as they are to particular requirements, it would be folly for us to reach the conclusion that we can now safely dispense with other weapons of proved worth. We cannot safely abandon any weapon until we are sure that we have enough of something definitely better which serves the same purpose.

"It is essential to remember that 'best' is not an absolute term, connoting a single best weapon or family of weapons exclusively capable of serving all purposes. . . . The Army's arsenal must be stocked with a well-balanced variety of weapons each fully adapted to a particular function, and each the best of its kind that modern technology can provide.

"The Army Ordnance Corps, which shoulders the responsibility for producing these weapons, is a key member of the Army team. Some measure of that responsibility can be clearly shown by what has transpired in the past five years. During this period nearly $35 billion worth of actual deliveries were received by the Army's supply system. It is interesting to note that 60 per cent of this total, or approximately $21 billion worth, consisted of ordnance . . ."

The Army is not bound by tradition—it is simply awake to realities. While we are reaching out fully to explore every possible avenue of approach to the better weapon in every category, to examine every idea however fanciful it may at first appear, we are at the same time determined to keep our feet firmly on the ground of practicality. That is just hard common sense.

We as a nation cannot afford in these critical times to abandon common sense in any particular. It would be grave folly for us to dispense prematurely with the tried and proved and place all our faith in the new, just because it is new and sensational and full of promise.

IT would be double folly for us to conclude that since we have already accomplished so much, we can safely tailor our research and development activities to day-by-day changes in world pressures or to the necessity for budgetary economies without regard to the necessities of our mission.

I am firmly convinced that nothing is more important to our future security than that these activities shall be carried on without any curtailment. In fact, increasing emphasis should be placed upon them. I am sure that today we have the best weapons of any nation in the world.

But we must soberly reflect that what we will use in the event of any future war will depend wholly upon the basic research, the exploration, and the experiments we will carry on during the next few years, and the development and production of a succeeding decade. What we fail to do today will cost us very dearly in the years to come.

What has been accomplished so far is really only a beginning. However, I have the greatest confidence that the teamwork of the Army and the other services and of American science and industry will continue to keep us safely ahead of any possible enemy in the technological race.

I know that America will meet every challenge of the future with the same ringing answer she has always made in the past: "What must be done, will be done."

Strategy of Disarmament

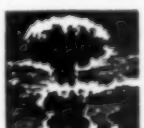
Limitation as to the use of military power rather than the size of armed forces and the amount of armament is the key to international peace and must have its foundation in world opinion and the moral law

Eugene E. Wilson

THE outcome of the current disarmament controversy may well determine the future of civilization, if not of the human race. Since the gulf between East and West is due to fundamental differences in basic concepts, the task of bridging it calls for strategy of the highest order. The first step in this direction is to appraise our own position from the standpoint of fundamental principles.

These principles can be readily established through a study of history. Unfortunately, the modern mind, impressed by the revolutionary character of scientific discoveries, is prone to disregard these principles on the assumption that the lessons of history no longer apply.

While this may be the case when it comes to tactics, wherein precedent or expediency are controlling factors, it is not the case with strategy. For, as Adm. A. T. Mahan, U.S.N., demonstrated in his discerning analysis, "The Influence of Sea Power Upon History," strategy is based upon immutable principle, and it is precisely in the field of strategy that history is rewarding.



Fortunately it is not necessary to go back into ancient history to discover the principles which underlie the problem of limitation of armaments. These can be found in the personal experience of the generation of men whose lifetimes span the first half of this century.

Immediately following the Armistice of 1918, the victorious Allies, having disarmed the Central Powers and finalized their action in the Treaty of Versailles, then proceeded to disarm themselves. To the Germans, smarting under their defeat, resentful of the vindictiveness of the treaty, encouraged by the weaknesses displayed by the League of Nations, and surprised by the folly of their late conquerors, the situation offered an invitation to rearm and seek vengeance in what became the Second World War.

Again, at the close of that war, the Allies—with the notable exception of the realistic Russians—repeated their earlier blunder. In so doing they invited the blockade of Berlin, the Cold War, the Korean war, the war with Red China and, save for the resourcefulness of American private industry, might well have brought on the third world war in a half century.

Thus history and personal experience establish the principle that disarmament is not only no guidepost to peaceful coexistence but is, on the contrary, a convenient means to national suicide.

The strategic principle involved is the elementary one commonly called "the principle of security." Since the chief purpose of all government is to provide security for its people, it follows that disarmament defeats the primary political purpose of government.

A FORM of limitation of armament was tried out by the world's sea powers between the First and Second World Wars. Commencing with the Washington Limitation of Arms Conference in 1922, an effort was made to reduce the cost of armaments through treaties establishing tonnage ratios designed to maintain the status quo.

This attempt at limitation as to *size* failed for two reasons: inadequate provisions for enforcement and the swift progress of scientific research and technological development which made a mockery of mere tonnage limitations upon which the ratios were predicated.

The "pocket battleship," the submarine, the airplane, and countless other creations actually made obsolete the capital ships—the gun carriers whose tonnage had established the least common denominator of the principle of limitation as to *size*.

Mr. Wilson, former president of the United Aircraft Corp., East Hartford, Conn., is not only a pioneer and leader in the aircraft industry of the United States, but also a deep student of military history and of human relations. He is a graduate of the United States Naval Academy, Class of 1908, and a nationally known advocate of a strong defense system for our country. He is the author of "Wings of the Dawn."

This afforded the Germans and Japanese an opportunity to gain sufficient superiority to encourage a resort to conquest in the attainment of ambitions otherwise beyond their reach.

With limitation as to size and disarmament discredited, we must go back to the Victorian era for a type of limitation which really worked. Then the *Pax Britannica* climaxed a century of limited wars which came to a close in August 1914. For, following the end of the devastating Napoleonic Wars in 1815, Western Europe relaxed in the sunshine of an enlightened world order which applied the principle of limitation as to *use*.

DURING this relatively peaceful interlude, a climactic period in Western Christian civilization, Europe emerged from domination by militant Continental minds—Napoleon, Clausewitz, Jomini—and entered the direction of creative maritime minds of the Elizabethan and Nelsonian schools.

This became the heyday of international law. This law, a product of treaty, convention and covenant, was supported by world opinion, enforced by overwhelmingly superior naval forces, and dedicated to the protection of lawful maritime trade and commerce.

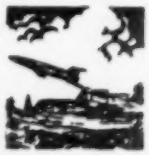
International law, in principle, outlawed the *use* of military force against urban populations. Further, it prescribed in detail and effectively enforced rules of civilized conduct in the *uses* of military force, under principles handed down from the days of chivalry and under precepts dictated by fundamental moral law.

The Geneva Convention, with its humanitarian principles as to military intercourse, and especially the treatment of prisoners, formed a cornerstone of limitation as to *use*, since abandoned for barbarism reminiscent of the Dark Ages when might often constituted right.

Limitation as to use was a natural product of the application of moral principles drawn from human history which time and time again had demonstrated the bankrupting character of scorched-earth tactics.

Such moral principles are no abstract product of religious dogma, but the result of human experience which, from the time of the Ten Commandments, has revealed again and again the fundamental restrictions which men must impose upon their own conduct if they would live together in reasonable security.

International law, for all its detailed imperfections, marked a high point in the progress of human civilization. It was an outgrowth of a deliberate program innaugurated during the creative Elizabethan era for the announced purpose of "endeavoring to keep the unity of the spirit in the bond of peace."



It was the fundamental law of a world social order designed to bring all social forces, military, economic, political, technological, and ideological, to bear in furtherance of that desirable end.

For example, military forces were assigned protective missions in the furtherance of free world trade. Economic forces were permitted to function under the general principle of free natural competition. Political forces were brought to bear generally through free voluntary associations impelled primarily by enlightened self-interest. Technology was directed primarily toward competition in quality of product and integrity of service. Ideologically this was a free social order functioning under natural law—as men were given to understand that law.

Of course this was not a perfect social order; it suffered under the usual limitations imposed by human frailties. It was neither wholly just nor wholly free. Yet it was an advanced social order which maintained relative peace to a degree not previously experienced, and not since even approximated. It attained desirable ends through the application of the principle of limitation as to the use of military force.

Furthermore, a natural limitation as to size was inherent in the principle of limitation as to use. By outlawing the use of military force against urban populations, the principle reduced automatically the targets available and, by restricting them to legitimate military objectives, limited the size of the forces required.

Again, the generally protective missions of armed forces exerted pressures in the same direction. Natural economic law functioned to the same end. Unconditional surrender gave way to conciliation and compromise and thus reduced destruction to a minimum.

Thus it becomes evident that the underlying principles of a social order which was still functioning at the beginning of the current century provide the master key to the solution of current problems.

The maritime social order broke down, not because it was faulty in principle, but because its principles were no longer applied. When scientific research and technological development began to produce weapons of frightfulness, social order gave way to social revolution—a product of self-styled "scientific" minds. With the advent of airpower and nuclear energy, civilization itself stood on the brink.

The history of this debacle can be traced to the beginning of the preoccupation of the human mind with material forces and its disregard for the spiritual forces of the universe. Many, lacking spiritual understanding, came to accept the defeatest prophecies of scientific minds that free Christian civilization was doomed.

YET a study of history, against a background of the actions and reactions of spiritual and physical forces in nature, leads to an opposite conclusion. Given inspired leadership, Western civilization can be expected to react to the challenge of the barbarian, from within or without, and to create an advanced social order based upon principles of greater freedom and higher justice which underlie the American or "Far Western" culture.

The basic failure in *Pax Britannica* was strategic. When Britain abandoned her announced policy of building two tons of shipping for every ton constructed by a possible enemy or combination thereof, she encouraged the Germans to challenge her Grand Fleet with a High Seas Fleet. Here again disarmament, or limitation as to size, can be charged with having invited the total wars of the current half century.

This reëmphasizes the elementary fact that no form of limitation of armament can be effective without the backing of an overwhelmingly superior force—physical and spiritual—in the hands of men of good will.

When this condition prevails, limitation as to *use* affords the only proven method. It can function only under the control of just and equal international law. Herein lies the basis of the American strategy of disarmament.

Against this background it is pertinent to examine current Soviet proposals for arms limitation. These contemplate the outlawing of the H-bomb and reduction in the size of armaments.

FROM the point of view of Soviet Russia, these proposals are entirely rational. They are calculated to remove the pressures of competition—military, economic, political, technological, and ideological. As long as the Iron Curtain screens Soviet Russia from inspection while leaving the rest of the world open to espionage, the Soviet will have all the advantages of early warning while denying that privilege to her opponents. And since treaty limitations upon her would be unenforceable, she can proceed without restriction upon her freedom of action.

From the point of view of the West, acceptance of such proposals is unthinkable. The alternative is to propose a return to the principles of limitation as to use, which Czarist Russia once accepted.

THE first step is for the West to reaffirm the principles of international law, dormant for four decades. The second step is an international conference called to amend the law in such a way as to bring advanced scientific discoveries under the principle of limitation as to use. Fortunately the old machinery stands ready at hand, though a bit rusty from disuse, and new machinery may be brought to bear to speed the coöperative effort.

Reaffirmation of the principle, subject to concurrent agreement on the part of Soviet Russia and Red China, would not only outlaw the H-bomb but go even further toward the restoration of civilized processes in the conduct of war.

The growing number of atomic detonations like this recent U. S. test emphasizes the urgent need for some form of international arms use limitations (Army photo).

The use of airborne or nuclear weapons against urban populations, as well as all other weapons of terror or destruction, would be outlawed by the simple fact that they cannot be pin-pointed on legitimate military objectives such as troop concentrations.

President Eisenhower took the first cautious step in this direction when during the Geneva Conference he proposed aërial inspection. Some observers criticized this plan as unrealistic and impracticable but, in principle, the President's recommendation simply contemplated doing away with the artificial barrier which today blocks any reasonable approach to the limitation of armaments among the nations.

Public approval of the President's proposal was not wholly the result of President Eisenhower's personal charm. To those familiar with the history of Western Christian civilization it made sense because it contemplated the restoration of freedom. And since freedom can exist only under the protection of just and equal law, it implied a return by all the countries of the world to the tried and true precepts of unobserved international law.

WITH the restoration of freedom to trade, no formal inspection becomes necessary because the intentions of all parties then become common knowledge. Moreover, with confidence restored and a feeling of security reëstablished, scientific developments can be redirected into constructive channels under the impulse of enlightened self-interest.

Thus it becomes evident that history is not just an epitaph on the tombstone of a dead civilization but, like the financial statement of a modern corporation, it points the way to higher levels. History, like the Ten Commandments, sets forth the fundamental law without which men cannot live together in any society.

RESPONSIBILITY for applying these principles resides with those who are experienced in their use, who have confidence in their efficacy, and who are determined to make them work. This fixes the responsibility for leadership upon Americans whose advanced culture—an offshoot of Western civilization—contains the germ of a higher social order. And, since the future of civilization, if not of mankind itself, depends upon the correct solution of this problem of limitation of armaments, ours is at once a great responsibility and high privilege.

Meanwhile, it is pertinent to emphasize again the overriding strategic principle that no form of limitation of armament can be effective without the backing of world opinion established on the foundation of moral principle and supported by overwhelming physical and spiritual force. The principle applies quite as well in a peaceful hamlet or in a world organization.

Preserving Armament Skills

A plan for an emergency reserve of critical trained workers

Harry L. Erlicher

IN establishing or maintaining a mobilization base from which production of military goods can be rapidly expanded, it is essential to the national defense not only that facilities, machine tools, and production equipment be included in our layaway program, but that skilled workers also be available in the event of emergency.

In some very few categories of labor the skilled worker specialists have almost become extinct because of the ingenuity of industry in developing push-button devices and automation that practically supplant the five senses formerly used by the artisans in their labors.

However, in production of military items certain of these skills are still required, and in any emergency the availability of such skills might well become a key factor in determining the quantity and quality of our production output. Certainly it is apparent that any degree of nonavailability could mean too little production and too late.

In seventy-five to ninety per cent of the trades or products which we use, I feel sure there would be no serious craftsman difficulty. But serious shortages of skills in certain critical groups could cause a complete bottleneck, and I feel that not enough thought or planning has been given to it.

IT is my carefully considered opinion that we should apply the same reasoning and planning to the production of "skilled workers" as we apply to facilities, machine tools, and production equipment; namely, (1) needed scarce or critical artisans, the proper training of whom would require a long lead time; (2) artisans currently not in excess or who are required for defense in numbers far in excess of peacetime needs; and (3) artisans needed for defense production of items which U. S. industry has had no experience in producing.

Until recently Mr. Erlicher was Special Assistant for Production and Programs, Office of the Assistant Secretary of the Army (Logistics). He served as president of the Association's Capital Cities Post, New York, during his long tenure as vice-president in charge of purchasing and traffic, General Electric Company, which office he filled until his retirement in 1951.

It seems to me imperative that a survey be made approaching every industrial company that is responsible for a layaway facility, and which is a logical manufacturer of the product made with those facilities, to find out what roadblocks would prevent their prompt use or conversion in time of emergency.

I would suggest further exploration within industry as to the probable emergency availability of skilled workers, and I would explore the prospects of training new people to make these products.

During World War II we were to a large extent still bound by the time-honored tradition that certain things could be made only by artisans from Switzerland, Sweden, Germany, France, and other Old World countries. But that tradition was pretty generally discredited, especially in the optical industry, when high-school students and older nonmechanics were enlisted and, in a very short time, with newly created scientific devices and production tooling, trained to make perfect ground lenses, etc.

Much could and should be done now to develop and train the man on the street to perform such jobs by the use of modern scientific production methods.

IN these less than ten critical "know-how" shortages I feel that the problems could be largely solved even if we were able to find or develop only one or two experts in each field who would have the ability to plan and oversee the prompt reëstablishing of a layaway plant as well as the "know-how" to produce the required article. Such an expert could save much time in getting started and in producing quality items.

He would be on a sort of Reserve officer basis, and each year we would have him spend two weeks or a month in a defense pilot plant, such as Rock Island, Frankford, or Watertown, so that he could keep up to date on production techniques.

The idea which I have outlined above is pretty much the pattern of the very large national construction companies which, through good times and bad, or even if they had no work at all, have always retained a very small skeleton staff of experts who are able quickly to start operations of any size, in any location, whenever necessary.

We would do well to adapt this successful pattern to our own defense activities if our stand-by layaway program is to be the dynamic, effective plan that will be needed should we ever be called on to fight another war.

Return of the Seaplane

Recent technological developments may enable water-based aircraft to solve the problem of mobile airfields required for tactical advantage in this age of possible atomic warfare

Joseph Goodyear

THE recent announcement by the U. S. Navy that the world's first nuclear-powered aircraft will be water-based serves to focus attention on the remarkable resurgence made by the seaplane since the end of World War II, and especially in the past five years.

The reëmergence of water-based aircraft—the result of several important technological developments coupled with some daring but logical thinking—promises to remold the tactics and strategy of aërial warfare along lines far different from World War II and even Korea.

Water-based aircraft, the pontoon seaplane, the flying boat, and the amphibian were very much in the foreground two and three decades ago. The safety factor in long overwater flights, the great load capacity, and the availability of the unlimited "runway" more than offset what were then only slight aërodynamic disadvantages—the added weight and drag of the floats or bulky hull of the flying boat.

Aëronautical progress, however, seemed to have forgotten the seaplane. The important new developments, the retractable landing gear, the powerful engines, the cantilever wing, the hard-surfaced runway, all favored the landplane. The performance gap between land-based and water-based aircraft, once negligible, widened to the point where the advantages of water-based aircraft were minimized, and even before the Second World War the seaplane was relegated primarily to the passive rôle of patrol work.

Mr. Goodyear is an aëronautical journalist whose articles have appeared in ORDNANCE, *the Journal of the Franklin Institute, and in other industrial publications.*

What, then, has returned the seaplane from semiretirement to an active rôle in offensive operations?

The basic reason is one of strategic necessity. The facts of nuclear warfare are such that, in many quarters, the thinking and planning regarding future bases of operation have altered considerably. As far as an aërial striking force is concerned, this reevaluation can be spelled out as follows:

Our retaliatory striking force today is tied to the long, hard-surfaced runway—to the airbase as it was known in World War II. In that war, however, maximum aircraft security could be obtained by dispersing the aircraft about the airfield. The magnitude of atomic destruction makes these dispersal tactics obsolete, for a few square miles is no longer an area large enough in which to disperse bombers.

Our striking force, therefore, land-based on a few airfields throughout the world, could conceivably be wiped out or severely decimated in a single mass attack. One bomb per airfield is now the simple mathematics of the problem, and the mere building of more bases does not change the arithmetic of destruction.

The only alternative to our present system, it has been pointed out, is not saturation, but mobility—airfields that can be moved, airfields with no fixed location, aircraft that need no runway—in short, a water-based striking force.

THE argument for this "bases unlimited" concept, as it has been called, is hard to dispute in theory—a water-based bomber force, supplied by units of the fleet or scattered on shore-line, nonrunway bases, and operating from water areas is, collectively, indestructible and a sure deterrent to aggressive action by a potential enemy.

The argument against this theory is a hard and practical one—fulfillment is technically impossible; a water-based air force is, because of certain aërodynamic considerations, a second-rate air force, incapable of meeting the requirements of modern warfare.

This has been true in the past. It is true today, but several technological developments of the past few years indicate that it may not be true tomorrow, and it is on these developments that the advocates of the "bases unlimited" concept place their faith. These aërodynamic advances are:

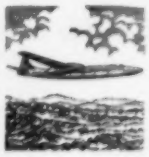
1. The development of new hull con-

figurations in flying boats that largely eliminate the severe weight-drag penalties of the past.

2. The development of small lightweight planing surfaces such as the hydro-ski, which eliminates the need for a bulky hull or floats, and the hydro-lift, which permits a landplane to operate from water as well as land.

3. The application of jet and eventually nuclear power to water-based aircraft.

With the exception of certain new hull designs, all these developments are in early experimental stages, and all have "bugs" that must be worked out. It is clear to even the most optimistic proponent of the seaplane that the transition from our present striking force to one balanced with water-based aircraft is still a long way off.



The progress that has been made in each of the three areas of development is sufficient, however, to justify a careful evaluation and to indicate the direction the work is taking.

The development of more efficient hulls for flying boats has been a major avenue of research at the Convair Division of General Dynamics and at Martin Aircraft, the two current builders of flying boats in this country. The effort to improve hull design is not new; it has been under way for some two decades. Much of the success along this line, however, is comparatively recent.

THE development of a flying boat hull has, in the past, been a compromise between the dictates of aërodynamics and hydrodynamics. The hull that was most efficient in the air—*i.e.*, carried the greatest loads with the lightest weight and least drag—did not perform well in the water. It lacked stability, resulting in violent "porpoising" and generally poor water characteristics.

The simple key to hull design is the ratio of the length to the beam. The high length/beam ratio hull, that is, the long, slim hull, is preferred aërodynamically; the short, stubby, low length/beam ratio hull is—or was—the only choice in the water. The lack of solution to this problem was the principal factor in the demise of the flying boat.

Since the airplane is essentially a bird and not a fish, research was geared to making the aërodynamically acceptable, high length/beam ratio hull suitable for water operation. This meant considerable testing—and water-tank, wind-tunnel, and theoretical research would not suffice. What was needed were tests with actual aircraft.

The myriad of design changes that were required before a suitable hull design could be found, however, made the use of real aircraft prohibitive from the cost standpoint. Hull design research was considerably handicapped by this factor until 1938 when Ernest Stout of Convair, reviewing the progress made by several Englishmen working on the same problem, introduced in this country the "dynamically similar" scale model, and with it the opportunity to test various hulls in air and water without the exorbitant cost of full-size aircraft.

The dynamically similar model, unlike the familiar wind-tunnel model, is not merely geometrically to scale but is an exact scaled-down version of the real aircraft in power, inertia, acceleration, and all aërodynamic forces and motion. Without the availability of the dynamic scale model the development of the flying boat as an offensive weapon would not have been possible.

Data gained from tests with dynamic scale models made possible the hull design of the new Convair R3Y, a hull five times as efficient as that of the wartime PBY flying boat and more than twice as efficient as those of flying boats now in regular patrol work.

The long, slim hull of the new R3Y is efficient both aërodynamically and hydrodynamically. Aërodynamic drag has been reduced considerably without the loss of load-carrying ability. On the water, porpoising and skipping have been brought under control, the effects of spray minimized, and rough-water performance bettered.

Along with the new hull efficiency came a marked reduction in the frontal area of the hull and a corresponding decrease in aërodynamic drag. This, in turn, made possible the incorporation of a low power loading—tremendous engine power compared to aircraft weight—and a resulting increase in aircraft performance. This was further facilitated by the use of relatively light turboprop engines rather than the traditional piston engines.

These innovations have given the R3Y performance comparable to that of a World War II land-based fighter aircraft!

The second model of the R3Y, the R3Y-2, incorporates a feature that indicates the direction taken by the new mobility concept. The bow of the R3Y-2 is hinged so that the entire nose of the aircraft can be opened to admit or unload men, guns, trucks, and other equipment directly onto a beach or dock.

THE unobstructed interior of the aircraft is large enough to accommodate three 2½-ton trucks or three 155-mm. howitzers. As a troop transport the R3Y-2 will carry 103 fully loaded troops. As a flying tanker the R3Y-2 will be capable of refueling eight fighters.

The second major technological development that has spurred the return of water-based aircraft is the planing surface, the hydro-ski and its cousin, the hydro-lift.

The hydro-ski was a coöperative undertaking by Edo Corporation, the Navy, and the Air Force, the National Advisory Committee for Aëronautics (NACA), Convair, and the All American Engineering Company.

The hydro-ski is an attempt to solve the problem of making the water performance of the seaplane square with its aërodynamic performance.

The bulkiness of the flying boat hull is made necessary by the demands of water operation, the strength and configuration required to withstand the high landing loads and the impact of rough seas. The small, light hydro-ski solves this problem by absorbing most of the hydrodynamic punishment in landing, before the hull hits the water, and on take-off by cutting the time the hull remains in the water on the take-off run.

When the aircraft is at rest on the water the hydro-ski, which is affixed

Left, the Convair Sea Dart, equipped with a single hydro-ski, prepares to leave the water as the ski absorbs most of the hydrodynamic punishment.

Right, wing floats, hydro-skis, and a watertight fuselage convert this C-123 heavy land cargo aircraft into an all-base ship. Below, the Martin XP6M-1 Seamaster, powered by four jet engines mounted in two housings above the wing, begins a take-off run.

to the bottom of the hull, is submerged. As the aircraft gathers speed for take-off the hydro-ski, which is actually an airfoil or, more correctly, a hydro-foil, lifts the hull out of the water at relatively low forward speed. In a normal flying boat take-off the speed required to lift the heavy craft from the water is such that the hull absorbs considerable punishment as it plows through the sea; hence the reënforced and bulky hull.

Once the hydro-ski reaches the surface it acts as an aquaplane until the entire aircraft becomes airborne. On landing, especially in rough water, the advantage of the hydro-ski is even more apparent. The V-shaped bottom of the ski (or skis), rather than the entire hull of the aircraft takes the high-speed impact of the wave crests. Skimming along the water on the hydro-ski until most of the forward speed is dissipated, the aircraft comes to rest on its hull.

Again, trials with dynamic scale models, this time conducted at NACA laboratories in 1948, made possible the first tests with a full-size aircraft. These latter tests, conducted with a heavy-hulled Grumman Goose amphibian by Edo Corporation, showed, among other things, that landings could be made in waves three times higher than would normally be considered safe for this type of aircraft.

The results of these tests indicated that the heavy hulls and floats of water-based aircraft could become a thing of the past.

The hydro-ski seemed to Convair, whose engineers had been working on the design of a water-based fighter, the solution to its hull problems. Until the development of the hydro-ski, Convair's work had bogged down on the same problem—the high impact loads to which the hull would be subjected in the open sea necessitated a hull design and structure that immediately handicapped its efficiency in the air. The hydro-ski eliminated the need for an undesirable hull design.

THE end result was the Convair Sea Dart, a delta-wing, jet-powered, water-based aircraft with performance comparable to a land-based fighter. In flight, with the hydro-skis retracted, the

Early tests with a Grumman Goose proved the value of hydro-skis in protecting the hull and eliminating bulky aircraft design.

Sea Dart looks like any land-based fighter. The traditional hull of the water-based aircraft is gone. On the water, the Sea Dart rests on its fuselage with the trailing edges of the wings actually touching the water. On take-off, the hydro-skis emerge as planing surfaces after a short run at the low speed of 10 knots, eliminating the heavy sprays that normally occur at higher speeds.

The skis of the Sea Dart also incorporate small wheels and brakes, not for land operation, but for self-beaching, making the Sea Dart a land airplane for such functions as maintenance, rearming, and refueling. Capable of supersonic speed, the Sea Dart, still in experimental stages, is the first water-based fighter truly a match for any landplane—a vital necessity if the "bases unlimited" concept is to become more than just a theory.

Another application of the planing surface, the hydro-lift, resembles the hydro-ski, but is nonsubmersible and is used only as an aquaplane. Developed by All American Engineering Company, the hydro-lift permits a landplane to operate from virtually any surface, including water, snow, mud, and runways. The purpose of the hydro-lift, unlike the other innovations, is not to make the water-based aircraft equal in performance to a landplane but to allow a landplane to operate from water without the weight-drag penalties of water-based aircraft.

The hydro-lift skis include wheels, enough of which protrude from beneath to allow the aircraft to operate from land. In a water take-off the aircraft lands on its skis, which provide enough lift to keep the aircraft on the surface provided the airplane continues to taxi at fifteen miles an hour or more. To stop, the pilot must run the aircraft onto a beach or simple landing ramp.

For a water take-off, the pilot begins from the beach or ramp, taxiing two or three times the length of the aircraft to pick up speed, then turns into the water for a normal take-off. The total weight of the gear, in the small aircraft tested thus far, is less than 100 pounds, and the speed of the aircraft is reduced by only two or three knots when the gear is retracted into the wing.

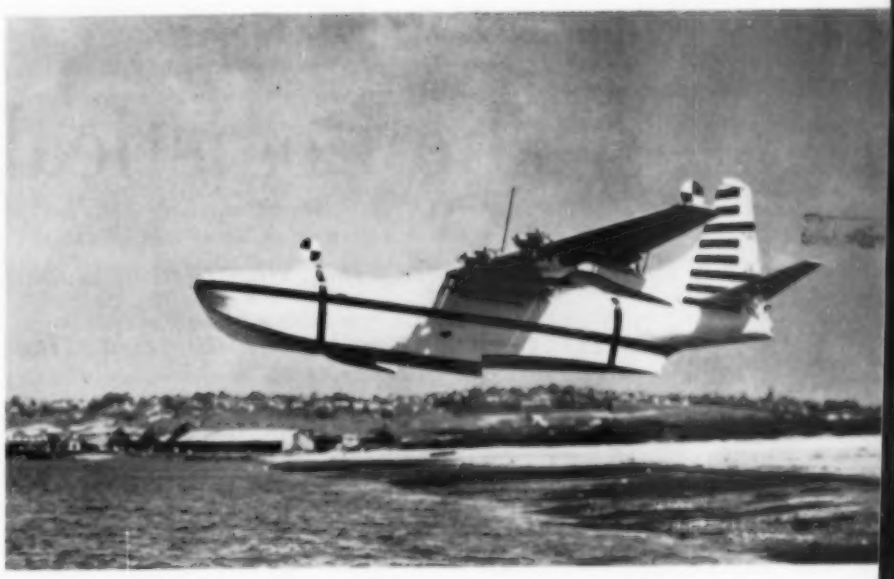
ALTHOUGH this type of planing surface has been tried on aircraft no larger than a Navy training airplane, the engineers who developed it state that there is no reason why it cannot be used on high-performance fighters or heavy bombers and transports. Bombers equipped with this gear could conceivably operate from one-airplane bases along a shore line, and fighters could operate from beaches without need for long airstrips.

Combining features of both the hydro-ski and hydro-lift Stroukoff Aircraft Corporation has modified a large, land-based cargo aircraft, the C-123, for water and land operation by making the fuselage watertight and by adding wingtip floats and hydro-skis. In the water the C-123 rests on its flat-bottomed landplane fuselage, with the skis submerged. As the aircraft picks up speed the hydro-skis lift the fuselage out of the water and into the air. In flight the gear is retracted. Wheels are provided for normal landings in fields and on runways.

The third major development that has hastened the return of the seaplane is the jet engine. In land-based aircraft the use of jet engines has required longer and longer runways, and it was natural to look to water-based aircraft

with their limitless and cost-free runways.

This factor will assume additional importance with the development of nuclear-powered aircraft. Shielding of crews from radioactivity, for example, will require heavy metal guards. The greater weight will, in turn, mean that even longer take-off runs will be required before the airplane can get off the ground. One of the advantages of the atomic engine will undoubtedly be its negligible fuel consumption, which means that aircraft landing weight, too, will be higher proportionally than it is today, requiring longer runways for landing as well as take-off.



The dynamically similar scale model of the Convair R3Y takes off on one of many low-cost testing operations which made possible finished design of the new aircraft.

ANOTHER and more positive reason why jet propulsion has influenced the design of water-based aircraft is that it permits the elimination of the propeller which, because it must ride high above the water, had forced still another compromise in seaplane design. Without the jet engine the Sea Dart, which rests on its wings, could never have been developed.

The extent to which the jet engine has influenced the design of water-based aircraft can best be seen in the new Martin XP6M-1 Seamaster. Powered by four turbojet engines, the Seamaster—a flying boat—is capable of speeds of over 600 miles an hour, comparable to our present land-based bombers.

Although the Seamaster is designed for mine laying and photo reconnaissance, it is not difficult to envisage an aircraft of this type as a long-range medium bomber. The watertight rotary mine door of the Seamaster could well become a bomb bay door.

The progress made during the past few years in the design of water-based airplanes has been encouraging, and proponents of the "bases unlimited" theory are growing in number. When these and other technological advances are perfected it will not be difficult to imagine a part of our strategic bomber force based, not on a few vulnerable airfields, but rather each aircraft equipped with hydro-lift landing gear and spotted every few miles along a shore line; or a force of aircraft similar to the Seamaster based anywhere on the seas, cared for by units of the fleet, and protected in the air by water-based Sea Darts.

Assault operations might be conducted swiftly with aircraft like the R3Y-2, shoving their noses on the beach to deliver men and material. The troops would not have to take the entire island to build an airstrip, as they did in the last war, for the fighters would be equipped with hydro-lifts and could operate from the beach as well as from carriers.

Equipped with a hydro-lift landing gear, a Marine OE-1 landplane makes an experimental water take-off after a beach run of two or three times its own length.

THESE tactics are, of course, a long way from being realized. Important steps in this direction have been made, however, and "bases unlimited" is no longer the dream it was once thought to be. It is not too far-fetched to believe that in the not-too-distant future whole armadas of aircraft, both military and civilian, will be using our "liquid runways," greatly enlarging the scope of our activity in these fields.

The Logistical Line

Problems of manning the extended and elaborate supply organization of the Army with experts who appreciate the importance of accurate requirements and firm production orders in a time of emergency

Lieut. Col. Ralph R. Todd

THERE is an apparent growing attempt to solve all our logistical problems from the continental United States (CONUS) base operation. More specifically, there is a developing trend that our CONUS operations are ends within themselves to the extent that we are not utilizing these installations in one of our most critical areas; *i.e.*, as on-the-job training grounds for the development of logisticians who will assume the responsibilities for the manning of any extended logistical lines in any future emergency. Such a trend should constitute real concern to our logistical planners.

This trend is the "push-button" concept which leans almost entirely upon a superefficient base in CONUS—efficient in the area of planning, in the establishment of requirements, in the procurement field, in stock control, storage, maintenance, and throughout the entire area of distribution.

THIS concept alleges that, with such an efficient base operation within the confines of our shores, there is no urgency to plan at this time for manning an extended supply line; that if we can establish such a superefficient operation in CONUS, the logistical extension will follow automatically.

In order to arrive at any conclusions relative to the training of logisticians in this field it is well to take a brief look at present attempts to modernize our logistics.

One representative plan under consideration is the development of a fast electronic communication system which will reflect the status of given items from a theater direct to a national commodity center in CONUS. The communication will take only minutes, as opposed to previous requisitions, which required several weeks.

On the same date, within a matter of hours, the commodity center will, based upon an international asset picture, direct via the fastest electronic communications possible the physical movement of these supplies from the point of availability nearest the customer.

In the physical movement of the item, continuous stress will be exercised to eliminate terminal points and thereby to reduce the handling and quantity of supplies in the pipeline. Each time supplies are set down, checked in, picked up on paper, placed in covered or open storage, then again checked out on paper, and again reloaded for further shipment the cost of handling supplies is multiplied.

Colonel Todd is currently stationed at the Letterkenny Ordnance Depot, Chambersburg, Pa. This article is based on a paper written while Colonel Todd was a recent student at the Army Supply Management Course, Fort Lee, Va.

Time in the pipeline requires greater quantities of supplies to keep the pipeline full. Economy of time through modernized communications, or reduction of terminal points will point toward a major contribution in economy of supply and consequently in our national resources.

Certainly, if we can modernize our system whereby electronic communication from an overseas theater will constitute a requisition, if we can reduce our terminal points, if we can speed up transportation, if we can reduce physical handling—the potential savings are tremendous.

The above representative plan is, of necessity, brief and grossly oversimplified, but it does reflect present attempts to modernize and streamline logistics. It is felt with reasonable certainty that we can approximate improvements along the lines described.

The successful operation of such a modernized system is contingent upon a very careful analysis at the originating point in the overseas theater where such an analysis establishes the theater level, determines requirements for the theater and, in fact, is the action which sets the entire supply system in motion.

Under a modernized concept, as outlined above, do we need to train men to maintain an extended logistical line? Will there be a need for personnel with "know-how" to man the line in the communication and combat zones or in

whatever logistical organization we may have in a given theater of operations? Will we need personnel with know-how in stock control, requirements, procurement, maintenance, storage—with these fields perhaps further broken down into specialized commodity areas?

Or, is it possible to operate the theater, as the trend presently indicates, by remote control through a superefficient system confined to home base while the home-base system (1) consolidates theater asset data, (2) determines theater requirements, (3) levels theater supplies, (4) handles theater maintenance problems, and (5) initiates the action from home base which will satisfy all theater logistical problems?

IT is submitted that under such a modernized concept the requirements for top-flight logistical personnel in the theater will become all the more urgent.

Those who were responsible for manning many of the positions in logistics outside CONUS in World War II and during the Korean emergency recall all too vividly how thinly spread were those with logistical know-how. There was during both of these periods a dearth of personnel with adequate experience in logistics. The criticalness of this problem was further accentuated by additional problems such as:

1. Use of indigenous personnel in logistical organizations. In addition to the responsibilities normally required at a CONUS installation, the utilization of indigenous personnel within the organization in an operational theater magnifies the problem of the logistician.

The logistician establishing and maintaining the organization must, therefore, have an intimate and detailed knowledge of each segment of the organization in order to organize it, train the indigenous personnel, and operate the organization, usually on an assembly-line basis. This often must be accomplished in spite of a language barrier.

2. Requirements from a combat theater. The supply requirements submitted from a combat theater, good or bad, are normally honored without question. The requirements, good or bad, then have their impact throughout the international logistical system. We know that faulty supply requirements and demands many times were established, because trained logistical personnel were spread too thinly; sometimes, because they had not previously received proper on-the-job training.

The result was that items were bought and placed in the system which were not needed, supplies which were not needed were shipped into the theater, and items urgently required were not shipped. Many of the supplies which were erroneously requisitioned for reasons stated above today clutter up our entire supply system—both in CONUS and overseas.

Over and above the initial dollar cost and the additional unnecessary drain on our economy and resources, this original cost has been compounded many times through costs in storage, administration, handling, inventory, and finally in the screening and disposing of the items—usually at a fraction of the acquisition cost.

During World War II, many of those in the logistical line recognized the problems and the inevitable mistakes being made. They rationalized then that we had not had an opportunity to train logisticians to man such an extended line. When the same problem presented itself again in the Korean emergency, many were confident that concrete action would finally be forthcoming through concerted training.

"The matter of placing more logistical know-how in theaters of operation has become increasingly urgent as we realize more and more that each and every item of supply is another drain on our economy and national resources. We cannot afford to continue with the concept of luxury we enjoyed in World War II and which we continued to enjoy during the Korean emergency. . . . The additional critical element is that of modernized weapons which we must assume will be directed against any worthwhile stockpile of supplies in the future. It is therefore essential that the theater very carefully avoid excess stockpiling of supply in the area."

The matter of placing more logistical know-how in theaters of operation has become increasingly urgent as we realize more and more that each and every item of supply is another drain on our economy and national resources. We cannot afford to continue with the concept of luxury we enjoyed in World War II—and which we continued to enjoy during the Korean emergency.

The additional critical element is that of modernized weapons which we must assume will be directed against any worth-while stockpile of supplies in the future. It is therefore essential that the theater very carefully avoid excess stockpiling of supplies in the area, as has been the practice previously; not only for reasons of economy but for urgent strategic reasons.

THE question is therefore again raised: Are highly trained logisticians required outside of CONUS and in the theater of operations? Have we reached a point where they are not required and we can operate our system on a worldwide basis under a push-button concept; *i.e.*, controlled from within the confines of our own shores?

This writer holds that the placing of trained logisticians in the theater of operations can perhaps do more than anything else during an emergency in controlling the quantity and type supplies moving into the theater to prevent over-receipts and overstockages and at the same time establish minimum requirements for essential items.

The question is then raised: What remedial action is being taken to train logisticians at all levels for an extended logistical line? If the "bell rang" tomorrow, if it rang two years hence, will we be prepared then to man such a line which may extend halfway around the world?

The requirement is not for short theoretical training but for that type of training which can only be acquired by manning a job—only by assuming responsibility for the performance of a job for a period of time sufficient to obtain a thorough and intimate knowl-

edge of the specific job and all elements of that organization. Any over-all plan for improved logistics is incomplete which ignores this vital phase of training.

ACTIONS cited below reflect the trend which indicates not only failure to take action to correct this situation but also actions which will aggravate the problem even further:

1. One of the larger technical services in many of its CONUS field-service installations recently relieved all personnel, who were in a status whereby they could be called upon to man critical logistical jobs in theaters of operation in times of emergency, from positions where they could possibly obtain the detailed know-how of logistics performance.

2. Top-level supervision is becoming concerned with the superefficiency of the CONUS supply activities to the point where there is an increasing resistance to use these activities as training grounds for those who will man critical positions in an extended supply line in time of emergency.

3. There is in particular a reluctance to assign enlisted career logisticians to any position of responsibility in a large CONUS installation. These noncommissioned officers are the real backbone in a theater of operation during an emergency and require continuous training on the job in CONUS installations to maintain their efficiency and know-how. These men are very often ignored when rotated back to the zone of interior after the emergency, but are expected to produce at top efficiency in any emergency.

4. Many circles are presently advocating that CONUS field-service installations be turned over to commercial firms, which would in turn probably mean the loss of these installations as training grounds for logisticians.

In summary, our problems of over- and undersupply are an extension of bad requirements and demands. The major portion of our logistics problems are in the sphere of spare parts. The spare-parts problem, which is our major supply problem today, is to a very large extent the result of oversupply to overseas theaters primarily due to the creation of demands from these theaters during periods of emergency. Any plan developed for improved logistics which fails to correct this problem is considerably short of the desired goal.

To move into another emergency in the foreseeable future without thorough training of logisticians for theaters of operation will result in the repetition of logistical errors resulting in oversupply, overprocurement, and the clogging up and bogging down of our system.

With reference to the new concept of supply, we are trying to develop it along the lines of faster communications, fewer terminal points, reduction of items in the forward area, and confining these items to the absolute minimum.

Will these concepts require less-qualified personnel? On the contrary, it is held that this concept will require better-qualified personnel. Better-qualified personnel will be required for the very careful review, analysis, and balancing of the reduced stocks and the maintenance of the streamlined and modernized system in the forward areas.

Efforts to establish a streamlined system of supply in overseas theaters which ignore the requirement of top qualified people for that area will break down or result in an operation far below the desired level under the stress of emergency operations.

We find a great deal of thinking and pressure directed toward a superefficient logistical operation in CONUS. This is extremely important and should be followed aggressively. However, let us not attempt to operate this system as an end within itself to the oblivion of other vital areas. Within the framework of this efficient operation, if it is to serve its maximum useful purpose, there must be sufficient nucleus to stretch many times beyond its present base. It must be flexible and it must be elastic. It must have within its confines enough trained personnel in all fields of logistics to move out anywhere and anytime to man similar installations.

The personnel sent forward from CONUS to man these jobs should be the best qualified with the best know-how because their job will be many times more difficult than a similar job in CONUS.

It is not the purpose of this discussion to try to weigh the relative merits of the manning of our CONUS logistical installations by industry, by Civil Service personnel, or by a combination of Civil Service and military personnel. It is considered essential, however, that the same people, and in particular personnel in the key jobs, man the CONUS installations who will also be called upon to man similar jobs in an extended logistical line.

THE following recommendations are therefore submitted, based upon whatever plan is finally adopted:

1. *Manning of CONUS logistical installations by a combination of military and Civil Service employees.* Under this combination, it is recommended that military personnel on active duty or in military reserve be assigned to responsible operational jobs in CONUS during peacetime as long as there is a potential requirement for such personnel on similar type work in theaters of operation in any possible emergency.

2. *Manning of CONUS logistical installations by Civil Service personnel.* Under this type operation it is recommended that military reserve personnel be assigned to responsible operational jobs in CONUS during peacetime as long as there is a potential requirement for such personnel on similar type work in theaters of operation in any possible emergency.

3. *Manning of CONUS logistical installation by industrial firms.* Under this type operation, it is recommended that military reserves be assigned to responsible operational jobs in CONUS during peacetime as long as there is a potential requirement for such personnel on similar type work in theaters of operation in any possible emergency.

It follows that each CONUS organization would require enough depth in it to fill vacancies as necessary in order to continue operation at the time key personnel depart for overseas assignment during the periods of emergency.

New Army Matériel

Above is a new 5-ton 8-by-8 cargo carrier designed and manufactured for Army Ordnance by Reo Motors, Inc. The novel wheel arrangement, with steering action on the four front wheels, facilitates cross-country maneuverability. Below is the special radar for detecting enemy mortars developed jointly by the Army Signal Corps and the Sperry Gyroscope Company.

THE WHITE HOUSE
WASHINGTON

Gettysburg, Pennsylvania
November 25, 1955

Dear Admiral Hussey:

Please extend my greetings to those attending the Thirty-seventh Annual Industrial Preparedness Dinner of the American Ordnance Association. I wish that I could be present to salute many old friends and fellow workers in person.

Through my experience with the Association for many of its thirty-seven years, I came to know of its immeasurable contributions to national security. Between two world wars the Association helped to keep alive the know-how of ordnance production. Through its various committees it has helped to solve armed forces production problems by application of practical manufacturing experience. Thus it has saved lives, money and material for our country.

All of you have my warm best wishes for a successful meeting and for the continuance of your fine work.

Sincerely,

Dwight D. Eisenhower

Vice Admiral George F. Hussey, Jr., USN (Ret.)
President
American Ordnance Association
Mills Building
Washington 6, D. C.

Armament Preparedness

The theme of the Thirty-seventh Annual Industrial Preparedness Meeting of the American Ordnance Association held at the Waldorf-Astoria Hotel, New York, on Pearl Harbor Day, December 7, 1955

THE men of ordnance gathered in New York in enthusiastic throngs on Pearl Harbor Day, December 7, 1955, to commemorate thirty-seven years of dedication to industrial preparedness by the American Ordnance Association. At the Waldorf-Astoria the entire day was devoted to meetings and seminars for the review and preview of those scientific endeavors that ensure that the United States will always have superior weapons. The theme was Armament Preparedness for National Security.

Day-long sessions were held in the spacious Starlight Roof where the meeting was called to order promptly at 10:00 a.m. Louis Polk, a vice-president of the American Ordnance Association, as presiding officer introduced Part I of the Kent Seminar on the Scientific Bases of Weapons. He noted that this seminar was in honor of Dr. Robert H. Kent, associate director of the Ballistic Research Laboratories, Aberdeen Proving Ground, Md., who this year completes forty years of leadership in the field of ordnance research.

The first speaker introduced by Mr. Polk was Maj. Gen. Leslie E. Simon, Assistant Chief of Ordnance for Research and Development, who once served as director of the Ballistics Research Laboratories. General Simon gave a masterful and sympathetic account of Dr. Kent's long career and his many contributions to ballistics and to the application of science in the development of weapons.

Rear Adm. F. S. Withington, Chief of the Navy's Bureau of Ordnance, followed with further accounts of Dr. Kent's achievements and their influence on naval armament progress. The Admiral also made note of the diminishing appropriations available for conventional weapons while missiles and atomic weapons are being improved and put into production.

Lieut. Gen. D. L. Putt, Air Force Deputy Chief of Staff, Development, rounded out the military picture by outlining the research program directed by the Air Force in its relentless search for more effective weapons.

AT the Armament Preparedness Luncheon, Stanley C. Hope, a vice-president of the American Ordnance Association was presiding officer. He called on Lieut. Gen. Levin H. Campbell, past president of the Association, to present the Campbell Medal to Dr. Kent, the guest of honor. Col. A. R. Del Campo, director of the Ballistics Research Laboratories who has been closely associated with Dr. Kent, read the accompanying citation.

The guest speaker, George F. Metcalf, general manager of the special defense projects department, General Electric Company, outlined industry's part in the research and development that leads to more effective weapons.

After the luncheon, Part II of the Kent Seminar opened under the direction of Robert L. Biggers, a vice-president of the A.O.A.

Dr. Hugh L. Dryden, Director of the National Advisory Committee for aëronautics, the first speaker, impressed his audience with the many fields of science that have been exploited to develop our present aircraft.

Dr. Norman F. Ramsey, Jr., professor of physics, Harvard University, confounded all but the most erudite with a brilliant exposition of his studies that would cast doubt on the completeness of the second law of thermodynamics.

Dr. John von Neumann, a member of the Atomic Energy Commission, in paying tribute to Dr. Kent gave the members greater appreciation of the vital part science must continue to play in the maintenance of progress and the advancement of civilization.

The dinner meeting was opened in the Grand Ballroom of the Waldorf sharply at 7:30 p.m. as 1,800 members and their distinguished guests rose for the National Anthem.

When the presiding officer, Maj. Gen. R. L. Maxwell, president of the New York Post, introduced the toastmaster, Vice Adm. George F. Hussey, Jr., national A.O.A. president, the meeting was electrified to hear Admiral Hussey read a message from the President of the United States (see p. 602).

THE President's message was followed by a ceremony in which the guest of honor, Gen. Maxwell D. Taylor, Chief of Staff of the Army, was presented with the Association's Crozier Gold Medal by Harvey C. Knowles, senior A.O.A. vice-president. The citation read by General Campbell states in part: "His understanding and guidance of the United States Army, now as its Chief of Staff, emphasize again the magnitude of his powers and of his devotion to duty, honor, and country."

After a brief speech of acknowledgment General Taylor talked frankly and with an earnestness that demanded close attention to the perils that threaten the security of this Nation unless planning for our armed forces can be based on a firm financial and legislative foundation for the long pull.

Logistics in Atomic War

The widespread decentralization required by the threat of atomic missiles has created unique problems of supply which must be solved to provide a firm foundation for our national defense structure

Robert J. Icks

Colonel Icks served with distinction in the Ordnance Department of the Army during the Second World War. He is a recognized authority in the automotive combat vehicle field.

NOW that the United States definitely is committed to the use of tactical atomic missiles in any future war, there is continuing speculation regarding the effects of such missiles on tactics. Similar speculation as to their effects on logistics seems to be even more significant.

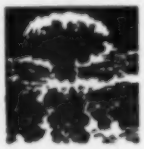
By the 1950 definition of Joint Chiefs of Staff, logistics comprises (1) all phases of the handling of military material from design and procurement through salvage and disposal; (2) all phases of the handling of personnel in the military establishment including training; (3) all matters concerning military facilities and installations from construction through disposal; and (4) all other services performed in or for the military establishment.

To touch on all phases of that definition is beyond the scope of a brief article. Instead, speculation will be limited to the over-all phases of some of the logistical problems likely to affect tactical operations.

PERHAPS the outstanding lesson of war since 1914 has been the tremendous increase in the importance of logistics in relation to both tactics and strategy. A war involving tactical atomic weapons unquestionably would raise logistics to an importance overshadowing tactics and to a large extent influencing strategy.

A simple comparison will illustrate the point. It has been estimated that it cost 75 cents to destroy one enemy soldier in Roman times, $3,000 in Napoleon's time, $21,000 in World War I, $200,000 in World War II, and $570,000 in Korea. It is any one's guess as to a probable future cost when atomic missiles are used, but it certainly will not be lower.

There is widespread belief that in the passing of the centuries firepower has become more deadly. But ever since the introduction of gunpowder to war, the volume of firepower has increased but its relative lethality has decreased. While the weight of projected metal has risen, the volume which never reaches its intended target has risen even more.



During the entire first World War the A.E.F. expended fewer than ten million rounds of artillery and mortar ammunition. American consumption in Europe alone during World War II averaged eight million rounds a month, and ammunition expenditure in Korea was even greater. Casualties percentagewise have not followed these tremendous increases in firepower, principally because of dispersion.

Early in the history of war individuals fought shoulder to shoulder. The continual development of weapons has constantly widened this interval. This eventuality led to the adoption of certain formations for dispersion and to take advantage of ground conformation and cover. With the employment of tactical atomic missiles such dispersion will be to another and perhaps different degree.

IN the public mind, atomic missiles are "total," but there are many factors to be considered. Relative lethality in atomic warfare may not necessarily increase, at least for combat troops. It must be faced, of course, that within a one-mile radius from the center of impact (or ground zero) of an atomic missile air burst, destruction is quite complete. But it also is true that beyond that radius there is little to fear. And current data appears to confirm that, under certain conditions, survival is possible even nearer than one mile from ground zero.

Before the advent of nuclear missiles, the effort was to prevent an enemy from concentrating—now he will be enticed or encouraged to do so. In the past, firepower has been an adjunct to mobility. Now mobility is an adjunct to firepower, both friendly and hostile.

Under ordinary circumstances, ground

troops in close contact with an enemy probably will be relatively safe since neither combatant knowingly would risk firing nuclear missiles which would endanger his own troops. For a depth of perhaps five miles the combat zone is likely to consist of small patrols operating as guerrillas and constantly on the move. Behind this area there will be rapid dispersions and concentrations of armored forces both by day and by night as each side seeks tactical advantage.

Thus the system of formal unit boundaries which began with trench warfare in World War I and has persisted since will be outmoded. Warfare will be too fluid.

In addition to dispersion, concealment and deception will have even more significance than they have had in conventional warfare. After the achievement of air supremacy in World War II and in Korea, camouflage was neglected. It must be revived and training in it and in natural concealment stressed.

However, of greatest significance is the fact that mere possession of nuclear missiles will not of itself guarantee the ability to deliver them at selected points or at all. Considerable time is needed after selection of a target area for determining the type of missile to be used, its power, method of delivery, and height of burst, to say nothing of the time required for fusing and for warning or alerting friendly troops.

MANEUVERS in Europe have shown that atomic artillery, for instance, could deliver a nuclear missile faster than could aircraft. But even then it took four hours at best from initial decision to delivery and sometimes three or four times as long. A great deal can happen to both friendly and enemy troop arrangements in that length of time. The results are likely to be that the number of such missiles actually delivered in mobile warfare against troops in actual contact with an enemy will be relatively few.

It would seem therefore that it is behind such combat lines where such missiles can be expected in some numbers. Therefore, under conditions of atomic warfare many breaks in supply channels may be expected. Logistics must be so organized as to function under the worst possible conditions. Supply as well as maintenance must be simplified and made austere and responsive.

If it is accepted that staff and line of communication troops will be more vulnerable to atomic attack than combat troops engaged directly with an enemy, our logistical system must be based on that acceptance. Of necessity such personnel will have fewer comforts and little rest than that in fox holes or under camouflage. Night work will be normal. Beer and Cokes, PX privileges, movies and entertainments, if they exist at all, will be fewer for all troops and especially for these.

Part of the logistical problem of the future is the time-honored formula that the impetus of supply is from the rear to the front. The inaccurate requirements and "shotgun planning" that filled the pipelines and slowed their flow in World War II due to intermediate stockpiling and rehandling must give way to other methods.

Under conditions of atomic warfare, field forces must learn to operate with smaller inventories. The volume of overall needs, dispersion, and the distinct possibility of catastrophic supply losses will be burden enough for the logistical chain.

We tend to overstock and to hoard. Planning will have to be precise. Lower supply levels will be mandatory, and supply administration must be greatly simplified. Requisitioning procedures today involve too much paperwork. Production lead time is well recognized, but supply lead time in World War II involved almost as long an interval.

We need to apply some of the methods used by modern mail-order companies, and we need to study and apply the highly efficient scheduling methods used by automobile manufacturers in order to reduce the number of tons handled in the pipeline as well as the number of times each ton is handled.

The simplified Ordnance stock system used in Korea was a step in the right direction. That provided for keeping on hand only some twenty per cent of the total number of spare parts eventually required for support. Yet ninety per cent of all Ordnance end items were kept operative on this basis. Much more could be done along these lines for all classes of supplies.

IN spite of the tremendous amount of experience which should be available there still is no scientific usage data on replenishment rates and parts allowances. Parts numbers, too, still present a great problem due to the lack of a single catalog. All efforts to create one have bogged down. Yet in atomic war, difficulties of procurement, production, and supply at home and in the field will be multiplied, and the need for such a single catalog will be even greater.

"Department store" depots will be a necessity, instead of requisitioning according to technical-service responsibility. Such overspecialization is wasteful of manpower and effort and exposes to potential destruction the entire supply of a given item or type of item.

The floating supply depots of the World War II Pacific theater will become a necessity for any overseas operation. The De Long dock or spud barge which can float, fix itself in place, lift itself above the damaging effects of storm waves, be removed, and act as a cargo carrier in the process, will be a valuable form of floating depot.

Ports, petroleum farms, railroad junctions, and loaded supply trains will be vulnerable in proportion to their value to the tactical situation. Many rather than a few ports will have to be used for overseas operations. Many scattered and mobile "department store" depots made up on vehicles and railroad trains may provide the best means of keeping land depots intact provided they are concealed and dispersed. Belt conveyor systems will help to keep such depots concealed.

Dumps also will be of the "department store" variety and will be smaller, dispersed, and numerous. Arctic bases will be vulnerable because conditions there are not conducive to dispersion.

Tactically, amphibious operations will

have to be spread over a larger area than in the past. Such operations probably will comprise many smaller coördinated landings separately supplied in order to avoid the danger of major concentrations both afloat and ashore.

Air supply will be used under special conditions only, as in the past. Air supply requires air supremacy or at least superiority in order to maintain flow. And it is axiomatic that with air supply a much higher overhead in maintenance and ground crews is needed proportionately to tonnage carried than for any other means of transportation.

It took 54 cargo ships and 5,000 men to move 100,000 tons a month across the Pacific during World War II. To move the same volume by air would require some 10,000 cargo aircraft, 128,000 men, 84 tankers, and 200 refueling airplanes, inclusive of overage for casualties, repairs, and air crew rest.

On the basis of such a comparison, supply of ground forces must continue normally to be on the ground. Little use will be made of the road network except at night and therefore fully tracked supply vehicles dragging sleds probably will be superior to wheeled supply vehicles for the resultant cross-country operation.

FUEL for supply and combat vehicles will be provided by pipelines laid by vehicles or helicopters. One such line can transport a daily load equal to that of 162 tank trucks of 2,000 gallons' capacity each. Such lines have the further advantage of reducing vehicle traffic load besides being dependable regardless of weather.

Yet immobilization of vehicles due to fuel shortages or high consumption because of the fluidity of operations would be very possible. If present limited radii of operation cannot be extended by improved design or the adoption of Diesel engines, liquefied petroleum gases or even steam power will have to be considered for both combat and administrative vehicles.

Maintenance in any theater is important. But maintenance in atomic warfare will be far more important than ever before because of supply interruptions. Commanders must recognize that maintenance is not performed without effort and that first-echelon maintenance must be expanded.

In tropical climates more time is required than in temperate climates. In the Arctic, field repairs take about five times as long as in moderate temperatures. In any climate, the use of complete assemblies instead of attempting detailed and skilled repairs seems more in keeping with the realities of atomic warfare in both supply and maintenance.

Allied to the logistics of matériel is that of personnel. The pipeline for personnel replacement during World War II assumed tremendous proportions just as in the case of matériel. It was found that it took some twenty-seven weeks on the average after initial training for replacements to reach combat units and two days for integration into those units. Usually there were eleven combat soldiers in the pipeline for every twelve in combat.

Perhaps it would be next to impossible to design a replacement system in the combat area which would meet the sudden high demands resulting from atomic explosions. But at least there must be an effort to "squeeze the fat" out of the pipeline in order to meet the needs of atomic warfare.

The volume of casualties could be high. Thus it may be necessary to provide tracklaying ambulances to augment present methods of evacuation of wounded by jeep and helicopter. A further step would seem desirable; that is to equip all cargo vehicles with litters and litter racks. They then could be used as emergency ambulances on return trips from regular supply channels, and truck (or tracked carrier) battalions so equipped would permit rapid evacuation of wounded.

ORGANIZATION is always geared to tactics and has a great bearing on logistics. The greater dispersion between units will require sweeping organizational changes for combat as well as logistical troops. Units must become smaller and more self-contained. Subordinate commanders must be given considerable leeway within their general missions, and this must extend down to the commanders of all echelons. Small units often will have to act on their own initiative, and small-unit leadership will become important.

Experiments have been going on in several countries to create smaller divisions. The basic organization of most armies has been based on threes. In combat this usually means "two up and one back." It is very likely that the greater depth demanded by atomic warfare may result in an organization of fours, fives, and even more.

IT is also likely that the armored division combat-command type of organization staffs and tailor-made units to fit given situations will be adopted for all division types.

Unit headquarters must be small and flexible. The so-called "chain of command" must be shortened so that there are fewer links. The fluidity required in atomic warfare would cause overstuffed and overstaffed units to bog down and become incapable of coping with rapidly shifting situations.

The fundamental problem of command always has been the ability to reach a correct decision quickly. As military forces became more and more complicated technologically, staffs increased in size. The result is that arrival at tactical decisions takes place less and less quickly. In addition to tactical responsibility, the practice of Western armies is to assign commanders the responsibility for logistics as well.

The consequent increase in size of headquarters staffs and the number of headquarters in the chain of command through which orders must descend tends to slow down both tactical and logistical orders. The same is true of the transmission of intelligence upward.

Each Army normally has 3 corps and 12 divisional headquarters, but there is no single headquarters for the 125 different types of service units responsible to 7 different technical services in addition to the Military Police Corps.

Although a few logistical commands have been formed, their functions are nebulous. A better solution would be to

adopt the armored division system of combining these under a trains commander. Separate air staffs and coequality of air and ground command complicate the problem still further.

IN future warfare there is a very grim possibility of complete destruction of any headquarters. This means that alternate headquarters and staffs must be provided for every larger unit with provision for either to become airborne at a moment's notice.

In the field, alternate command-post locations will be necessary because of this danger of complete destruction. The alternate positions will have to be staffed sufficiently to function in the event the original command post is destroyed.

Skeleton staffs will not do. Unless both originals and alternates are pared down to equal size and are trained and permitted to function alternately and interchangeably, chaos will result.

Staffs are responsible for the normal tactical, logistical, and administrative functions and the security of their units. They must also be responsible for these matters as they apply to nuclear missile delivery sites.

Added to this will be the responsibility for plans to shift forces because of very large losses, for plans to lose or absorb lower units and resultant changes in the situation without malfunctioning, for panic control, for lateral communications, and for traffic control, both of military units and civilian refugees.

ALL staff units and individuals will need training in greater responsibilities and nuclear technical skills so that they can function under conditions of atomic warfare. Such individuals thus will be better qualified for advancement which can and probably will be rapid.

Our recent tendency for higher echelons to do all the thinking and planning for all subordinate echelons could well be examined critically. Younger officers and noncoms now are expected to carry out orders according to the book. Company and higher commanders are burdened with making reports continuously to top echelons as to how well orders and plans have been carried out. Initiative is frowned on. These tendencies must be reversed and freedom of action encouraged.

"Part of the logistical problem of the future is the time-honored formula that the impetus of supply is from the rear to the front. The inaccurate requirements and 'shotgun planning' that filled the pipelines and slowed their flow in World War II due to intermediate stockpiling and constant rehandling must give way to other methods.

"Under conditions of atomic warfare, field forces must learn to operate with smaller inventories. The volume of over-all needs, dispersion, and the distinct possibility of catastrophic supply losses will be burden enough for the logistical chain."

These new and changed responsibilities on the surface may appear paradoxical in reducing staff size. But greater stress must be placed on self-reliance, initiative, and leadership in both the combat and service units. The tendency of staffs to plan down to individual units will have to be changed. By this one means alone, reductions in staff size will be possible.

In the combat zone, logistical services must be under one staff head. Other cuts must be made to achieve the needs for smaller, more flexible, and duplicate staffs which then can revert to their original intent—special skills to assist a commander in making a decision but not themselves commanding.

Centralization of authority is desirable in matters of policy, but decentralization is desirable in matters of thought and initiative. There is need for greater acceptance of a principle expressed by F. O. Prior, president of Standard Oil Company (Indiana):

"The greatest stimulant to competent people is a feeling of personal freedom, freedom to think and plan boldly, freedom to venture along new and untried paths and to take calculated risks. . . ."

He was referring to the commercial world, but since war has become a business, and a highly complicated one, his statement could apply to warfare as well.

It is definitely certain now that nuclear missiles are explosives—terrible but tiny as compared with the power involved in a hurricane or even a thunderstorm. Tactical operations will be possible for military forces but the keys to survival and success will be training, maneuver, austerity, and discipline. This applies to the logistical support of such tactical operations as well.

It is equally certain that hardships and lack of comforts will be the rule in future warfare for both combat and logistical troops and for headquarters staffs. Dispersion may cause loneliness, and morale may suffer, but the situation is far from hopeless.

If war should come there will be opportunities for combat audacity in the fields of both tactics and logistics. Solid and realistic organizational planning now will ensure that these opportunities can be grasped.

Amphibious tracked vehicles may be needed as cargo carriers in future warfare.

Are Planets Habitable?

With the space ship only a step behind the intercontinental missile it is important to determine beyond doubt whether the atmospheres of Mars and Venus contain enough oxygen to support human existence

Maj. James R. Randolph

IN the century following the discovery of America, the nations of Europe determined their futures for a long time to come by the decisions they made concerning the exploration and settlement of this new world. More immediately, the trade with these colonies provided foundations of shipbuilding and sea experience on which strong navies could be built. Of a navy without this foundation a British officer said: "You don't have to fight it—just keep it at sea!"

In the twentieth century, history seems likely to repeat itself. In a world divided between hostile ideologies, contracts are being let for the construction of satellites which can be put into orbits around the earth to circle there indefinitely as little man-made moons.

A nation which can build a satellite vehicle can, with more money and effort, build a space ship capable of going to the moon, or Mars, or Venus. It can with *less* effort, build an intercontinental ballistic missile (ICBM) capable of carrying a hydrogen bomb from Kalamazoo to Krasnoyarsk, or vice versa.

THE relation between the space ship and the ICBM is even closer than the relation between warships and merchant ships in the days of sail. For if we look ahead to the time when both the former are engineered for mass production and easy transportation it seems likely that most of the stuff that goes into them will be packaged in cans of standard size, so you have to read the label to tell what the cans contain.

A convenient size is 8½ feet in diameter by 15½ feet long. A can of this size might be an orbiter in which two people can live while picking up other orbiters and putting them together to form a space ship. It might contain machinery or packaged cargo frozen into ice for skip landing on the moon. It might contain a hydrogen bomb, with ice to keep it from being overheated when coming back into the atmosphere.

The designer of the rocket doesn't have to know what is in the can. All he cares about is its weight, the acceleration it will stand, and how much of a load he can put on top of it. Then he adds boosters, also standardized, to bring it up to the necessary speed.

This article was inspired by a recent interview with Maj. Gen. L. E. Simon, recently retired chief of Army Ordnance Research and Development, published in U. S. News and World Report.

Major Randolph was formerly in the Army Ordnance Reserve. He is executive vice-president of the newly formed American Rocket Research Association, a student organization to encourage amateur interest in research on rockets and space travel.

If he needs five boosters to put it into a satellite orbit he would need only four to make it an ICBM, and the one he leaves off is the biggest and the hardest to build. He would need more than five to make it a space ship, but he could shoot these out into space as separate loads and assemble them in the satellite orbit.

EVEN a dictatorship finds it difficult to maintain efficiency over a long period in an industry concerned exclusively with preparations for war. A free country is likely to find it impossible, especially when the danger of war seems remote for whole decades. Hence if wars of the future are to be won with the aid of the intercontinental missile, the whole future existence of a nation, and all it has, may depend on its interest in using for space travel the personnel and equipment the ICBM requires.

Because everything we have is at stake, the question whose answer decisively affects our interest in space travel may appropriately be called the "sixty four zillion dollar question."

That question is whether man could breathe on Mars or Venus. Other worlds are known to be airless, or too hot or too cold, or too far away.

At the present time, negative answers for both Mars and Venus are widely accepted by astronomers. They are the ones in the best position to know—but are they right? With so much at stake we cannot afford to trust them blindly.

An expedition to Mars, to determine the facts by direct observation, would be well worth its cost and will probably be made. Yet the saving on financing charges for this expedition might easily justify the expense of earth-based research which could prove that oxygen is there.

THE evidence for both planets is spectroscopic. If you examine sunlight with a spectroscope you find its continuous spectrum broken by dark lines, known as Fraunhofer lines, caused by the absorption of light of certain wave lengths by gases in the cooler outer atmosphere of the sun, and in the atmosphere of the earth. These lines are characteristic of the gases in the atmosphere and enable the astronomer to determine what gases are there.

In this way helium was discovered in the atmosphere of the sun before it was discovered on earth. Its discovery on earth began with the discovery in a mixture of earth gases of the same lines which had been seen by the spectroscope in the atmosphere of the sun.

To separate the absorption spectrum of the earth's atmosphere from that of the sun it is necessary to use the spectroscope on sunlight whose source has the largest possible movement toward or away from the observer. This is done by choosing the late afternoon when the observatory is going away from the sun, and looking at the side of the sun which is going away from the earth. Absorption lines produced by the sun's atmosphere will then be shifted toward the red end of the spectrum and will be separated from the same characteristic lines produced by the earth's atmosphere.

It can be done in the morning, looking at the side of the sun which is coming toward you, in which case the sun's lines will be shifted toward the blue. The amount of shift, in either case, is proportional to the relative speed, and the greater the shift the easier the separation becomes.

As the relative speed is generally less than a mile a second and the speed of light is 186,000 miles a second, the shift is small, but it is adequate. Moreover, the relative intensities of earth and sun lines can be measured so that the relative amounts of a gas in the two atmospheres can be estimated.

TO make a similar measurement on the atmosphere of a planet a configuration is chosen so that the point observed on the planet is moving as fast as possible toward or away from the observer. Then again the lines produced by the planet's atmosphere are shifted toward the red or toward the blue compared to the lines produced by the earth's atmosphere. A comparison of the strengths of the lines ought to show the relative amounts of the gases in the two atmospheres—but does it?

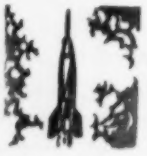
There seems little doubt that the

The highest known photograph of the earth taken at the height of a 158-mile climb by a Navy Viking II rocket during recent tests at White Sands Proving Ground, N. Mex. The area pictured includes the Rio Grande, looking toward Mexico (Navy photo).

spectroscope is telling at least a part of the truth when the lines observed are strong. Thus the atmospheres of Jupiter and Saturn show strong lines of ammonia and methane, which are almost wholly absent in the atmospheres of earth and sun. The atmosphere of Mars shows carbon dioxide lines twice as strong as those of earth, and the atmosphere of Venus shows very strong carbon dioxide lines. Neither of these planets shows lines of ammonia or methane.

But when the spectroscope gives negative evidence—when it says that a certain gas *isn't* there—could it be mistaken?

The spectroscope currently reports "No oxygen on Mars." But it formerly reported an absence of water vapor also. Presence of water vapor, and its amount, can be proved in other ways, however. For when the Martian polar cap begins to melt in the spring its temperature is observed to be that of melting snow, and it is surrounded by a dark blue band that looks like a marsh.



Snow, water, and water vapor are then present together, and the partial pressure of the water vapor could not be more nor less than that given by the steam tables for the triple point. Most astronomers now accept that value, at least for that locality and that season.

SIMILAR evidence might be developed for the presence of oxygen on Mars, despite the spectroscope's negative evidence. For we know that on earth both ammonia and methane are produced by natural means and released into the air. They are destroyed by oxygen. Hence it seems a reasonable guess, and it should be easy to prove or disprove by experiment, that an atmosphere without oxygen would contain detectable amounts of one or both of these gases. Conversely, an atmosphere containing large amounts of both could contain no oxygen.

In deciding how far we can trust the negative evidence of the spectroscope it is necessary to consider what happens to the energy which is absorbed when light passes through a gas.

Modern theories, which seem to be pretty well established, tell us that a molecule of gas will absorb only certain wave lengths of light. These are absorbed in units known as quanta. The absorption of a quantum causes an electron to move from one energy level to a higher energy level. Soon the electron falls back and in doing so gives out a quantum of light of the same or a longer wave length, each wave length being characteristic of the gas.

This reradiated light is going in all directions, but the light we get from a planet, being reflected from a rough surface, is going in all directions too. Hence it seems possible that the dark-line spectrum we are looking for may be just balanced by a bright-line spectrum of reradiated light.

This would be more likely to happen with a gas that is present in large quantities in the upper atmosphere and might give the impression that such a gas is wholly absent, whereas a less abundant gas, confined to the lower atmosphere, would show. This is something which could be proved or disproved in the laboratory.

Also subject to laboratory experiment, without involving the large cost of astronomical observatories, is the relation of plants to a planet's atmosphere. Plants absorb carbon dioxide from the atmosphere, use the carbon, and throw the oxygen away. They use some of that oxygen but not all of it.

In a vivarium, or in a balanced aquarium with an airtight cover, the carbon dioxide content comes down on a sunny day and rises at night. Experiments in such simple enclosures might shed much information on the question of whether an atmosphere's carbon dioxide content tells us how much oxygen is there.

The blue-green areas of Mars behave as if they were vegetation. The "canals" behave as if they were strips of vegetation within shopping distance of a railroad. The fact that both photograph dark by infrared light, whereas earth vegetation photographs white, does not necessarily mean that "only low forms of plant life are possible on Mars."

ON earth a black surface exposed to full sunlight can acquire a temperature up to 247 degrees Fahrenheit. On Mars, the corresponding temperature is 113 degrees. Hence we might expect Mars vegetation of the highest forms to have a fondness for infrared comparable to that of plants which on earth are found only in shady locations.

The author is currently working on a theory that looks as if it would permit the prediction of the kind and amount of atmosphere a planet is likely to have. This theory gives a scientific explanation of the following facts:

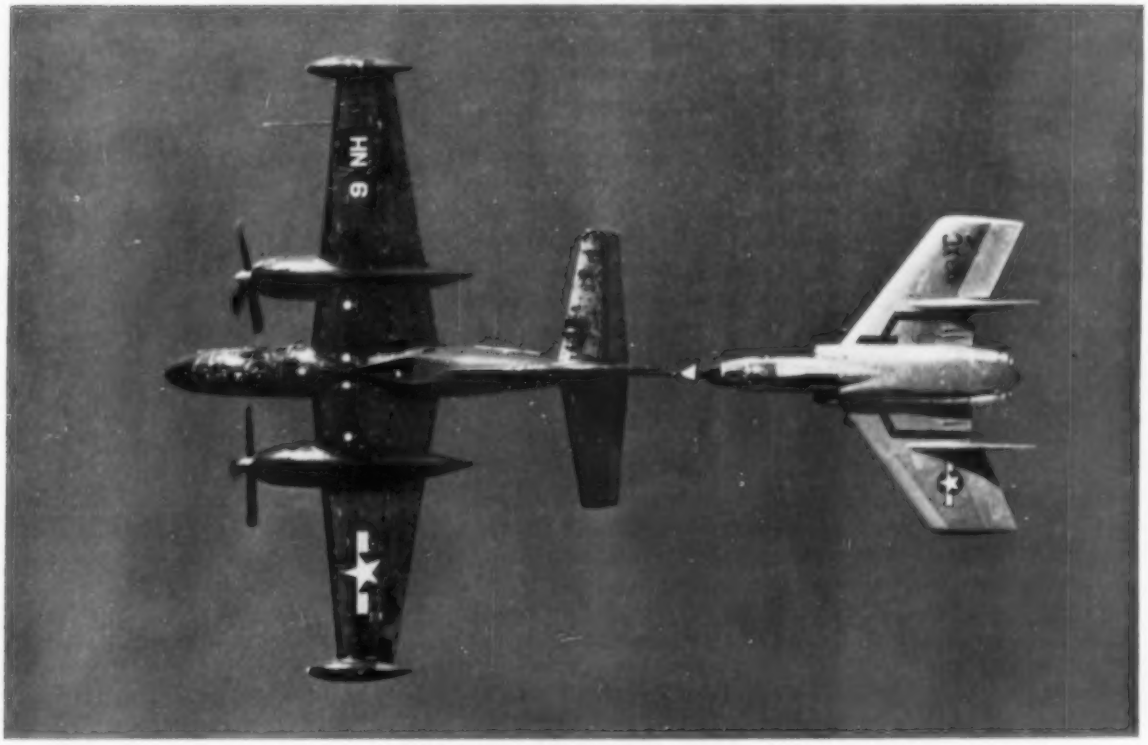
1. An airless world keeps the same face toward its primary.
2. A planet with an atmosphere rotates at a speed which is a mathematical function of its size and density.
3. The density of the planets decreases from earth to Saturn, and then increases from Saturn to Pluto.
4. Saturn's satellite Titan has an atmosphere. Jupiter's Ganymede, of the same size, has none.
5. The large light planets, whose atmospheres are believed to be mostly hydrogen and are known to contain ammonia and methane, are so far from the sun that sunlight can't melt ice. Nearer planets are denser, and do not contain these gases.

A THEORY which explains and correlates these facts can be extrapolated to predict the atmosphere of Mars, and gives it an atmosphere to which man could adapt himself.

These and other considerations are indicative of the tremendous importance to be attached to current progress in the field of long-range travel, both by piloted and pilotless vehicles. Research requires limitless imagination, and our defense authorities would do well to leave no stone unturned in these directions, for the old adage still applies—"truth is stranger than fiction!"

"A nation which can build a satellite ship can, with more money and effort, build a space ship capable of going to the moon. . . . It can, with less effort, build an intercontinental ballistic missile capable of carrying a hydrogen bomb from Kalamazoo to Krasnoyarsk, or vice versa."

Refueling on the Fly



The range of fast Navy jet fighter aircraft is being greatly extended by the use of in-flight refueling. An F7U-3 Cutlass twin-jet fighter, above, is shown gassing up from a drogue-equipped AJ-2 tanker airplane. The Cutlass, shown below, also can take on fuel in flight from another standard fighter, increasing operational flexibility (Navy photos).

MRS. WILLIAM CROZIER

The American Ordnance Association

announces with grateful appreciation the gift by the late

Mrs. William Crozier

Widow of Maj. Gen. William Crozier, Chief of Ordnance of

the Army, 1901-1918

of

CROZIER HOUSE

1735 Massachusetts Avenue, N.W.

Washington, D. C.

to be national headquarters of the American Ordnance Association

CROZIER HOUSE

UNDER the terms of the will of Mrs. Crozier, the Ordnance Association is to receive her home in the Nation's Capital. In making this gift the will states that it is done at the request of her late husband, Maj. Gen. William Crozier, who was a founder of the Ordnance Association in 1919. It was the wish of General and Mrs. Crozier that their home become national headquarters of the Association. The Association is also given $25,000 for the provision of a library in the house. The furnishings of the house other than certain personal effects and Chinese works of art are likewise left to the Association.

Crozier House is situated adjacent to Du Pont Circle on one of Washington's main thoroughfares—Massachusetts Avenue—on which are located many of the principal embassies in the city. The house is tastefully furnished and landscaped, is three stories in height, and is approached by a side and rear garden. It had been the home of Mrs. Crozier's parents since before the turn of the century and was occupied by General Crozier until his death in 1942 and was the residence of Mrs. Crozier until she passed away August 2, 1955.

Mrs. Crozier also left the sum of $300,000 to the United States Military Academy for the construction of Crozier Hall, "primarily for use as a meeting place and lodging for graduates at the United States Military Academy, West Point, N. Y.," of which General Crozier was a graduate as a member of the Class of 1876.

The Executive Committee of the American Ordnance Association at its meeting, September 15, 1955, accepted Crozier House with expressions of thanks and admiration for General and Mrs. Crozier's interest in the Association since its founding and for this most generous gift.

SINCE the devise was originally made, the membership and operations of the Association have increased manifold so that, if used, extensive additions will be required. Studies are now being made by the Association of the feasibility of such modifications as will be required for use of Crozier House as national headquarters. Whatever plans are decided upon by the Association's Board of Directors they cannot become effective until the property is unconditionally transferred to the Association. The period of probate of the will expires in October 1956.

The gift of Crozier House typifies the constant enthusiasm of General and Mrs. Crozier for Ordnance leadership in the United States. Their generosity will stand always as a memorial to their patriotic fervor for armament preparedness in the United States. Membership of the Association will be kept advised as plans progress, looking toward the fulfillment of Mrs. Crozier's generous bequests.

New Lightweight Handguns

The trend toward less bulky weapons has sounded the knell of the caliber .45 automatic pistol and has turned the spotlight on two new guns—the Colt and the Smith & Wesson 9-mm. automatics

Capt. Charles B. Haslam, U.S.M.C.

DURING our Philippine campaign, conducted from 1899 to 1902, the U. S. Army forces in that area of action were dismayed in discovering that their handguns, a variety of Colt and Smith & Wesson caliber .38 revolvers, did not possess the stopping power required to defeat the fanatical charges of the Moros.

History records the fact that the Moros bound their nerve centers so that any pain from inflicted wounds would be minimized. Therefore, any but direct hits in the heart or head of the onrushing Moro were ignored, and, as a result, numerous American positions were overrun and destroyed.

To remedy this inability of the caliber .38 bullet to stop the natives, it was decided to adopt a handgun capable of discharging a heavier bullet. The weapon chosen for this special purpose was the caliber .45 revolver, Model 1909, manufactured by Colt.

THIS weapon fired a blunt-nosed lead bullet weighing 255 grains at a velocity of from 770 to 810 feet per second. This bullet contained the power required to stop any adversary, whether his nerve centers were bound or not.

In the year 1911 Colt's Patent Fire Arms Manufacturing Company developed the handgun with which we are all familiar—the Colt automatic pistol, caliber .45, M1911. This pistol was developed to replace the Model 1909 revolver, and it did, but since the Philippine campaign had ceased it came too late to fulfill its mission in that skirmish.

Captain Haslam is currently serving on the Marine Corps Equipment Board, Marine Corps Schools, Quantico, Va.

This potent weapon, which proved itself again and again for forty-four years, might be replaced in the not-too-distant future.

The trend toward lighter weight is upon us, and those in a position to judge claim that a caliber .45 handgun is no longer required; that its need ceased after the Philippine campaign; and that its cartridge is too low powered to penetrate the new body armor and helmets worn by modern soldiers.

Tests have proved that stopping power is primarily the result of shock which is derived from the temporary cavity caused by the impact of the bullet. The higher the velocity of the bullet, the greater this cavity; the larger the cavity, the greater the stopping power. Therefore, we can see that stopping power is not altogether dependent on the size of the missile but rests to an even greater extent on the high velocity of that missile.

The NATO countries have decided that perhaps the optimum-sized missile for handguns would be that of the 9-mm. Luger (parabellum) cartridge. This cartridge, although smaller than the caliber .45, has a velocity of 1,200 feet a second as compared with only 830 feet a second for the .45. The 9-mm. is a potent round and is superior to the caliber .45 bullet at least with respect to penetration.

While considering this 9-mm. ammunition, it might be worth while to mention that the United States is one of the very few major powers still adhering to the caliber .45 handgun ammunition. The majority of all major foreign powers utilize the 9-mm. Luger (parabellum).

IN 1952 the United States, United Kingdom, and Canada agreed that the caliber 9-mm. ammunition (parabellum) should be standard for all three nations. "Parabellum" means "for war," and when used in conjunction with "cartridge" (for example, "parabellum cartridge") it indicates a cartridge of greater power than is necessary for commercial use.

As this article is being written there are at least three handguns on the market in this country which fire the 9-mm. cartridge. These are the Colt Commander automatic pistol, 9-mm. parabellum, which is manufactured by the Colt's Manufacturing Company and the Smith & Wesson 9-mm. Luger which is manufactured by Smith & Wesson, Inc.

The Smith & Wesson pistols are available in two models—the regular

type single-action semiautomatic pistol and the double-action type. Both models are essentially the same except for the double-action feature which operates for the first shot only, after which the hammer remains in the rearward position and subsequently operates by single action.

This double-action feature, it is said, is incorporated to enable the shooter to draw rapidly and get off his first shot in minimum time without cocking the hammer.

NO attempt will be made to discuss the functioning of the pistols except to say that they are similar to the automatic pistol, M1911A1. However, it might be interesting to note that the pistols are extremely light in weight.

The Colt Commander, 9-mm. Luger, and the Smith & Wesson 9-mm. models weigh less than twenty-eight ounces. This is a distinct saving over that of the caliber .45 automatic pistol, M1911A1, which weighs 39.1 ounces. The figures given are not the firing weights of the handguns.

The Colt automatic pistol, caliber .45, M1911A1, measures 8.5 inches in overall length as compared with 7.87 inches for the 9-mm. Colt Commander and 7.10 inches in the case of the Smith & Wesson models.

Although the trend is toward lighter weight for ordnance matériel, it must be kept in mind that too much weight cannot be eliminated because the recoil of a very light handgun firing a high-velocity round would be excessive and detrimental to accuracy.

	Luger, 9-mm.	*Automatic, cal. .45*
Bullet weight	125 grs.	230 grs.
Complete round weight	194 grs.	327 grs.
Velocity at muzzle	1,150 ft. per sec.	830 ft. per sec.
Velocity at 50 feet	1,112 ft. per sec.	815 ft. per sec.
Velocity at 150 feet	1,050 ft. per sec.	785 ft. per sec.
Penetration at 15 feet	10 pine bds., ⅞"	6 pine bds., ⅞"

Comparative weights, velocities, and penetrations of caliber .45 and 9-mm. handguns.

The new lightweight automatics, which are technically semiautomatic in operation, are made for the most part of aluminum alloy. The barrels of these pistols are much shorter than that of the M1911A1 which measures five inches. The 9-mm. Colt Commander has a barrel length of 4¼ inches and the Smith & Wesson models have barrels measuring about 4 inches in length.

The magazine capacity of the new lightweight pistols has been increased —nine rounds in the case of the Colt Commander and eight rounds in the case of the Smith & Wesson models.

It should be emphasized that this Nation is not committed to the adoption of a pistol, but the door has been left sufficiently ajar to permit consideration of a lightweight revolver capable of handling the 9-mm. parabellum ammunition.

As a matter of fact, a revolver has its advantages. However, it should be pointed out that difficulties are being experienced in converting or developing a revolver capable of firing the 9-mm. round and still remaining light in weight. The standard caliber .38 cartridge develops about 18,000 pounds per square inch compared with approximately 39,000 p.s.i. pressure with the 9-mm. ammunition.

No revolvers capable of firing 9-mm. ammunition are in existence today in this Nation or any other. Unless suitable lightweight, economical frames and cylinders can be developed that can withstand the high pressures of the 9-mm. ammunition and still offer sufficient safety margins, it is believed that the only alternative will be a pistol.

The above table points out how weights, velocities, and penetrations are affected when moving from a low-powered cartridge to the 9-mm. Luger (parabellum) ammunition.

ACTUALLY the velocities and penetrations of the 9-mm. ammunition depend on the load. This ammunition varies from 1,050 feet a second to as much as 1,500 feet a second, and the latter round may be fired from pistols as long as they are in excellent condition.

Thus, another time-honored member of the weapons family may be replaced. Whether the lightweight pistols under discussion would be suitable for military use must be determined. However, as light weight becomes more important many new types will appear.

The Colt 9-mm. Luger automatic pistol, Commander model.

Smith & Wesson 9-mm. Luger automatic, double-action model.

"Mystery" Bullets

Some of the unusual projectiles employed in Civil War ammunition were used to clean powder fouling from the bores of rifles and machine guns and to give a buckshot pattern with rifle calibers

Col. B. R. Lewis

NEARLY every one interested in small arms is familiar with the common "Minié" bullet of the Civil War period. However, several other interesting and distinctive special-purpose projectiles, then listed in Ordnance documents as standard types, are now either almost unknown or are unrecognized when found.

This article describes the principal types of bullets falling in that category, except those of an explosive nature, which were covered in the May-June 1954 issue of ORDNANCE.

One of the commoner "mystery" bullets found on Civil War battlefields is that invented by Elijah J. Williams about 1861. He took out two patents, one, No. 43,615, dated June 19, 1864, and the other, No. 44,492, dated September 22, 1864. The purpose of his bullet was to eliminate the bore fouling caused by black-powder residue, thus easing loading and improving accuracy.

Fig. 1. Williams rifle bullet, Type I, 540 grains.

Extensive tests, conducted at Springfield Armory by Master Armorer Allin, proved the new idea to be practical. After several hundred rounds the loading was still easy and the accuracy was at all times after the first few shots slightly better than with the service load. No wonder the Williams bullet was immediately adopted. Starting in 1862, each packet of ten rounds of caliber .58 rifle ammunition contained one Williams cartridge.

Colonel Lewis is a well-known weapons historian and an expert in the field of small arms. His most recent contribution to ORDNANCE *was "Early Small Arms" which was published in the January-February 1955 issue of the magazine. Colonel Lewis has just completed a tour of duty with the Ordnance Section, Headquarters, Korean Communications Zone.*

Williams' basic idea was to put a thin, dished washer, slightly under bore diameter, concave side forward, against the flat base of the bullet. The washer was made of a metal softer than the steel barrel—in the case of the service load, zinc. It was centered by a protruding boss on the base of the bullet, which was riveted through a hole in the washer. Chamber pressure flattened the washer, expanding its edges against the bore and scraping ahead of it any fouling left by previous shots. Figures 1 and 2 show this bullet.

Williams soon after developed a second type (Figure 3) which had more positive action. A lead disk, the same diameter as the washer, went behind it. The disk included a plug about ⅛-inch in diameter which passed through the washer into a hole in the bullet base. This is the type usually found, whether on battlefields or in surviving cartridges. The zinc parts of Williams bullets that have been long exposed to the elements usually have been eaten away. Often the separated bullets or base plugs are found.

Fig. 2. Williams pistol-carbine bullet, Type II, 540 gr.

Such bullets or their parts can be recognized easily by comparison with the full-scale illustrations on these pages which include the kinds usually encountered. Figure 6 shows Williams cartridges and Figures 1, 2, and 3 several of the types of bullets used in them. The more common rifle cartridge wrapped in plain paper is not shown as it was exactly like the others except for color. The pistol-carbine specimen (Figure 6) shows the color contrast.

The two sizes of cartridges in which Williams bullets are sometimes found are those for the caliber .58 rifle and for the caliber .58 pistol-carbine. Prior to the Civil War it had been the custom to identify special loads by colored or stained cartridge paper or by colored packet wrappers. The Dragoon revolver cartridge was yellow, that for the Cadet musket was red, and the like.

Fig. 3. Williams rifle bullet, Type II, 570 grains.

This custom carried over for a while in the Williams cartridges. Dark blue or pinkish-red papers were sometimes used to identify them. Most of those now found intact were of late manu-

facture, so are of plain, standard cartridge paper.

These late ones can be distinguished from standard cartridges by their rounder bullet points and by the gap between base plug and bullet, which can be felt through the paper by judicial examination. The sort without the base plug and with the same nose contour as the Minié bullet cannot be recognized conveniently short of taking the cartridge apart—a delicate task considering the age of the paper. However, an X-ray photograph will do the trick with no damage. That technique helps to solve many problems on unidentified paper ammunition.

Fig. 4. Shaler sectional bullet cartridge, M1855 rifle-musket. Total weight, 754 gr.

The lighter Williams bullet loaded in the M1855 pistol-carbine cartridge had me guessing for a long time, as by 1862 that arm was pretty well out of use—superseded by the revolver. I have found, however, that this smaller cartridge was made up specifically for the "Union" or "coffee-mill" machine gun, which was used quite extensively in the war. This early machine gun required the bore-cleaner bullet in order to function properly.

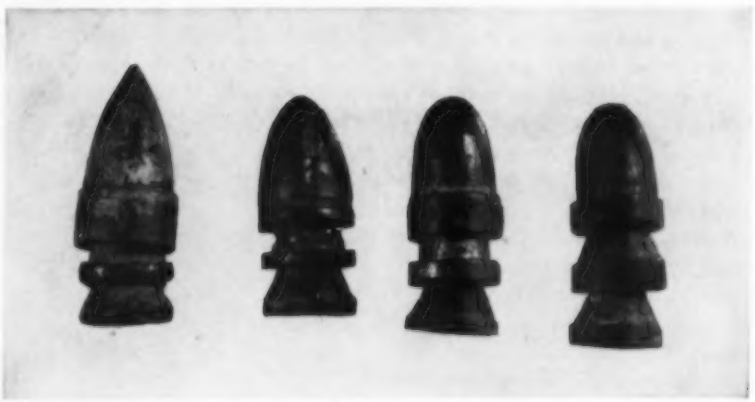


Fig. 5. Shaler sectional bullets, left to right: caliber .62 for unknown rifle; caliber .58 for M1855 rifle-musket; variation of caliber .58 with flat base; further variation on caliber .58 bullet with hollow-based bottom segment.

The cartridge was loaded into a heavy steel auxiliary chamber with a musket nipple at the back. The loaded and capped chambers were put in a hopper magazine and fed to the barrel by a hand-crank mechanism.

The tip-off on this ammunition was in a letter to Ordnance from a unit on the Mississippi. It complained about receiving "regular" ammunition for the "Union" guns instead of the necessary special light-load Williams cartridges. The steel chamber is too short for the standard cartridge but takes that for the pistol-carbine perfectly.

For some reason late in the war, Ordnance decided to discontinue using the Williams bullet. There were stories that the men thought they harmed the bore, though Springfield tests had shown an actual improvement after several thousand rounds when compared with standard loads. Perhaps it complicated supply too much, or was too expensive.

At any rate it was desired to use up the large supply on hand, so first four, then as many as six Williams cartridges were put into one 10-round packet. Thus, at certain times, it may have been the most common bullet in use by the Union forces.

In 1865 and 1866, Springfield tried

Fig. 6. Williams cartridges showing, left to right, cartridge for M1855 pistol-carbine and Union machine gun wrapped in standard paper and using Type II ball; for M1855 rifle-musket in red paper, Type II ball; blue-paper-wrapped cartridge.

some experimental Williams bullets in calibers .44 and .50 metallic cartridges. There may have been some small commercial production—I have heard of a Williams breechloader in about caliber .44. But after the 1860's, though it had been successful, the idea seems to have been dropped.

Another freak projectile commonly found by battlefield gleaners is that known as the "Shaler sectional bullet." When the old caliber .69 smoothbore musket was standard, the "buck-and-ball" load, consisting of one round ball and three buckshot nested together, was always popular. It patterned well up to 100 yards' range. At that distance, the typical pattern had the three buckshot in an 18-inch circle, with the round ball near its center. And the center was about at the point of aim. This was verified, in early 1954, with 90-year-old ammunition.

Buck-and-ball was always recommended for brush country, uncertain targets, night skirmishes, and particularly for Indian fighting, which often combined all these conditions. In fact, during the War of 1812 buck-and-ball was the standard musket load.

In 1855, when the Army reduced the bore of its small arms to caliber .58, it was no longer practical to use a buckshot cartridge for the shot would have been too small to have been effective. However, the need still existed.

On August 12, 1862, Ira W. and Rueben Shaler obtained patent No. 36,197 which covered a compound projectile for use in a rifled barrel to give the effect of buckshot. Their idea was to nest three relatively short conical balls together, fire them as a unit, then let them separate on leaving the barrel. Each element had its own rotating band to engage the rifling.

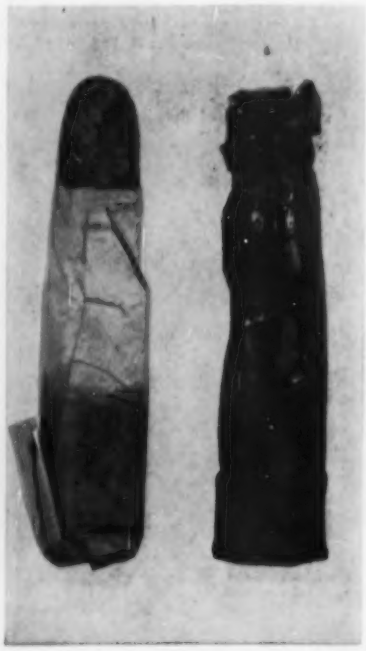
Shaler cartridges are quite distinctive. They were packed four in a cardboard box, with appropriate loading instructions on the printed label. The cartridge was loaded by first pulling out a cardboard disk in the bottom of the paper tube by means of a knotted string attached to a hole in the center of the disk.

Then the powder was poured into the barrel and the rest of the cartridge rammed down, leaving the 3-piece bullet held together by the paper wrapping. Figure 4 shows such a round.

Several variants of the Shaler bullet are known, probably as made by different contractors. Some are shown in Figure 5. The idea of a multiple bullet has since had several brief revivals.

Fig. 7, above, left, caliber .69 ball projectile; center, variation of same projectile; right, experimental projectile, long sabot.

Fig. 8, below, Mefford subcaliber cartridges: left, ball cartridge for caliber .69 musket; right, buck-and-ball for caliber .69.



The third projectile of this discussion is the one listed by Ordnance in 1865 as the "Mefford subcaliber bullet." On April 18, 1865, David M. Mefford was granted patent No. 47,317 covering this "improvement in cartridges for small arms." This one is still pretty much of a mystery to me, and if any reader has further leads I would like to know of them. A packet or a box label might give significant data.

Figure 7 gives a good idea of what Mefford's bullet was like. A relatively small and light projectile is pegged to a larger wooden base or sabot. This base has diagonal flutes, presumably to cause rotation in flight. First some of these bullets like Figure 7 turned up, then a cartridge minus powder (Figure 8) but looking as if it might have held a normal charge for that late date. At that point it seemed likely that this was a short-range practice round, using a light caliber .50 bullet in the caliber .69 musket.

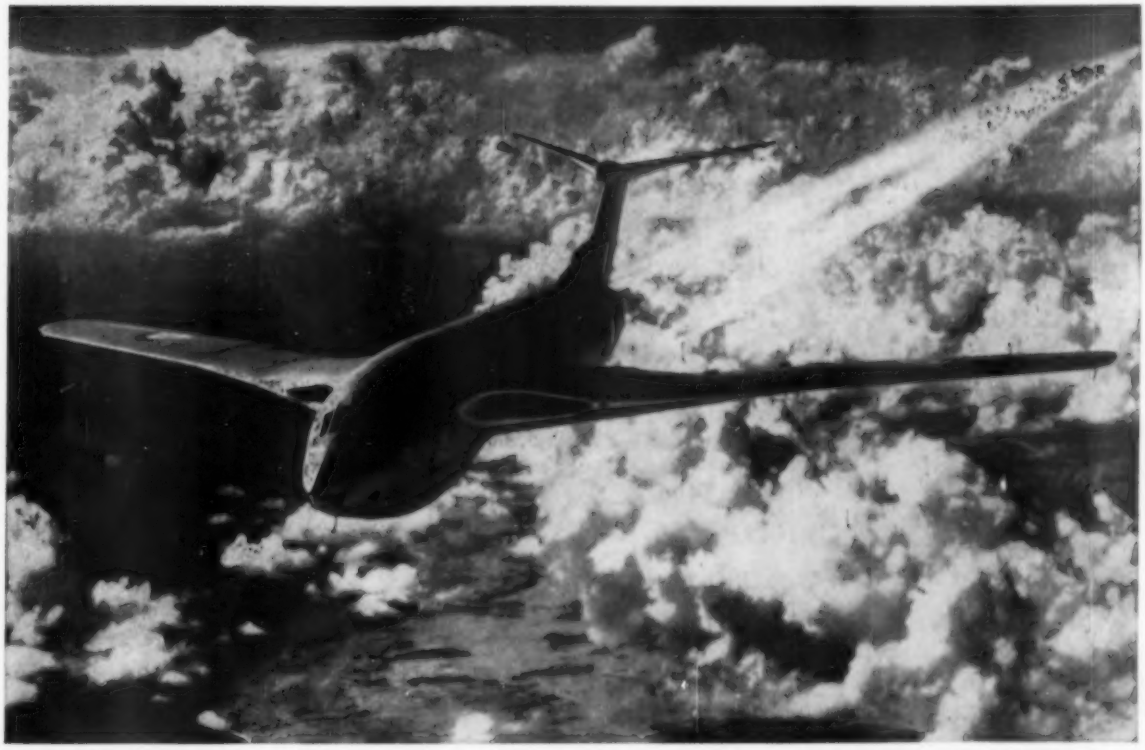
Then I happened to find another Mefford patent for a "subcaliber artillery projectile" described as "producing high velocity for penetrating bunkers and other defenses made of timber." This seemed to indicate a like intent for the musket-size load. But then the round also shown in Figure 8 was found. (The paper has been discolored by shellac or varnish.) This one is buck-and-ball, of all things! It contains three buckshot between heavy wads, plus a Mefford bullet just like the first one.

This just doesn't add up right, for the buck-and-ball load is placed in this cartridge inverted, like an Enfield load. That is, the buck are first, then the bullet, pointing toward the powder charge, possibly to preserve a solid base for the buckshot.

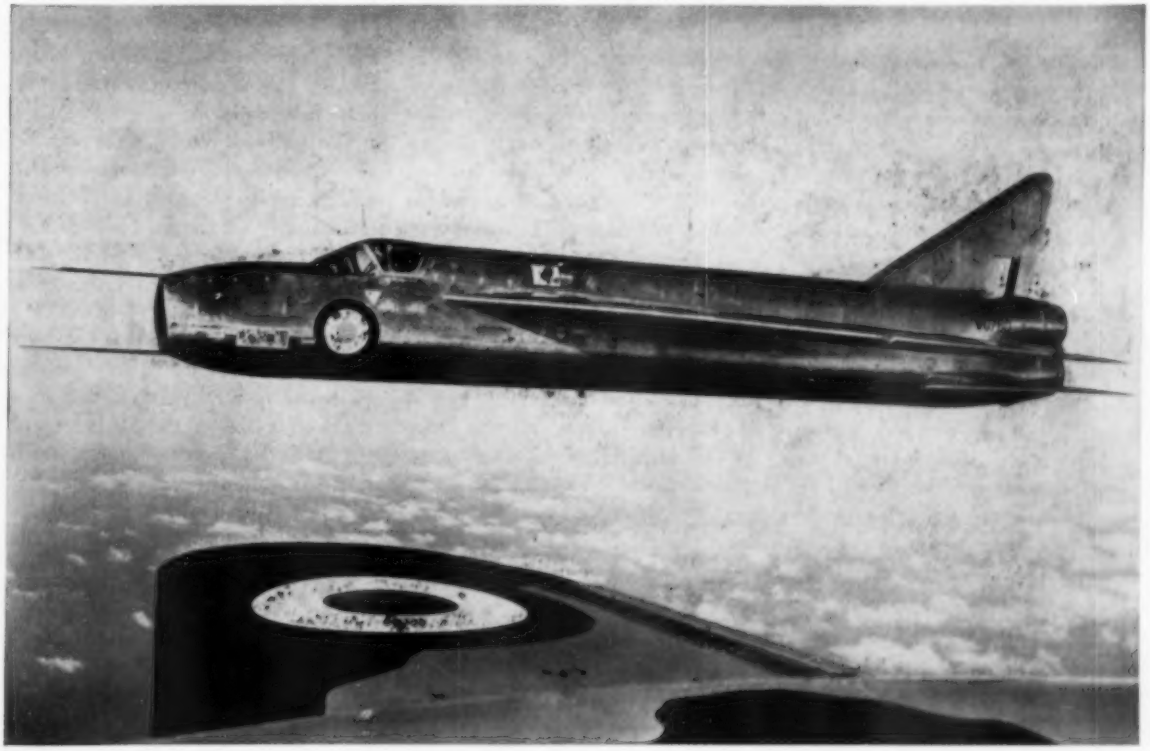
Here is another "ordnance mystery" still awaiting solution!

Editor's Note.—In the article by Colonel Lewis on "Explosive Bullets," published in the May-June 1954 issue of Ordnance, he wrote: "The American Civil War of 1861-1865 provided a great stimulus to arms and ammunition inventors (although) many of the ideas then tried out were later forgotten."

Recent British Aircraft



The Handley-Page Victor 4-jet crescent-winged bomber, above, is in high-priority production for the Royal Air Force. It has a loaded cruising speed of 700 m.p.h. at altitudes up to 60,000 feet. The Electric P-1 interceptor-fighter, below, first British airplane to top the speed of sound in level flight, was put through a heavy testing program (British photos).



Month by Month: Highlights of the National Defense

Stockpiling Know-How

The article in this issue by Harry Erlicher (page 592) is of unusual significance. It underscores a weak link in our chain of armament preparedness. Coming from the pen of an experienced and farseeing industrial executive of this country, the timeliness and cogency of Mr. Erlicher's frank statement is emphasized and the need for some remedial action made more apparent.

Mr. Erlicher, after nearly 40 years in executive assignments with the General Electric Company, was until recently an adviser to the Army on production problems.

In his trenchant analysis Mr. Erlicher stresses a major problem dealing with the lack of available skilled workmen in the event of another national emergency.

Experience in recent and distant troubles has left in the minds of those who lived and suffered through them the deep conviction of the seriousness of the current situation. Unless some such action as is proposed by Mr. Erlicher is taken, grim experience may be repeated.

The problem of an adequate reservoir of skilled workmen, especially in the making of heavy castings, is universal the world over. It is true of Europe as well as the United States.

When one visits major foundries in Europe, he is struck by a situation similar to the one prevailing here, particularly with respect to the producers of large castings and forgings.

Europeans are slightly better off, perhaps, due to the fact that there is still a strong family tradition in the foundry business. Children follow in the footsteps of their parents and traditionally engage in the same kind of work. Furthermore, foundry practice in Europe does not neglect, as we are so frequently inclined to do here, the training of replacement personnel.

Add to this the amazing shortage of large casting facilities in the United States, particularly when compared with European facilities, and the point made by Mr. Erlicher is doubly serious.

The specific problems of facilities for heavy castings and the required skilled manpower for armament preparedness, as well as for peacetime needs, are of first priority.

It is our considered judgment that the Defense Department, and particularly the Office of Defense Mobilization, would do well to take Mr. Erlicher's very practical recommendation speedily to heart.

Ordnance Extension Course

The Ordnance School of the Army at Aberdeen Proving Ground, Md., offers specialist courses in the automotive, armament, ammunition, fire-control, and supply fields.

The Parallel Extension Course of the Ordnance School now offers seven similar courses by correspondence which, in the main, parallel the resident courses having the same title.

These correspondence courses are offered to nonresident officers, civilian employees, and enlisted men of all components of the Army. They are free, and even the postage is covered by franked envelopes. Textbooks and necessary equipment are furnished on a loan basis to the student.

For the first time in Ordnance history a golden opportunity is offered the soldier, through extension-course study, to increase his knowledge of the doctrine and subjects now taught at the Ordnance School.

With respect to an enlisted man, the courses or subcourses he would like to receive by mail must be related to, or provide training in, his present or prospective duty assignment.

If the potential student holds a Reserve warrant or commission, the Associate Ordnance Officer courses or subcourses by mail offer a means of increasing his commissioned potential.

For the successful completion of a correspondence course a diploma is given, just as in the case of resident graduates. Certificates of completion are given for finishing up one or more of the several subcourses.

The new policy is a welcome advance in military educational procedure. The long-time custom of granting diplomas only to those in residence at the Ordnance School reacted against the earnest seeker for improvement who could not be spared for assignment to the school.

Army Ordnance has solved this problem in highly commendable fashion. The Parallel Extension Course will pay off handsomely in morale increase as well as in increased work potential.

Wingless Missiles

Charles E. Wilson, Secretary of Defense, has given the green light to the development of a middle-range wingless missile.

Such a missile would be supersonic and would have the capability of destroying targets more than a thousand miles from the firing site.

The Air Force was given the primary rôle in developing the intercontinental guided missile. Research and development efforts will be pressed to achieve this ultimate weapon. These wingless missiles may be equipped with atomic weapons.

Mr. Wilson's decision was based on recommendations of the Joint Chiefs of Staff and apparently put an end to a controversy between the Air Force and the Army on the issue as to which service should develop and control a weapon in the thousand-mile range.

Although the decision favors the Air Force, the Army and the Navy will work on a weapon in the middle-range class. Work will continue at Redstone Arsenal in Alabama where the Army has a group of distinguished German scientists carrying on experiments in the guided-missile field.

One of these developments is the Redstone. This missile is reported to have a range under 200 miles but is showing promise of developing a great deal more.

In the pioneering guided-missile field, Mr. Wilson apparently feels that competition between the Air Force and the Army and Navy, within limits, is a good thing. So say we all!

Small Business Boosted

The Defense Department announced recently that it is going to give small business a chance to supply more of what the armed services need.

An order already has been issued to military procurement officers specifically designed to reserve more work for small firms.

According to Reuben B. Robertson, Jr., Deputy Secretary of Defense, he and Defense Secretary Wilson "are going all out to work with the Small Business Administration and do our job together."

In concrete terms, the Defense Department has devised the following 3-point program:

1. Items that the military needs and small business can provide will be reserved by procurement officers for the bidding of little firms whether or not a Small Business Administration representative is present to look out for small companies.

2. Business will be set aside for awarding to a little firm when two or more small business suppliers are available, rather than a larger number of little suppliers, as has usually been required.

3. Classified items will be screened for potential reservation for small firms.

During the past two fiscal years, according to Small Business Administration figures, small business has averaged 19.6 per cent of the defense procurement business. This is a healthy sign as long as ability to produce a quality product on time and without a price differential continues to apply as it now does.

Atomic Warships

The Navy has ordered two more atomic-powered submarines. The submarines are part of a program which calls for the construction of eight nuclear-driven underwater boats.

One of the submarines will be an attack-type vessel. The other will be a radar picket submarine—one that carries special radar equipment for scouting assignments and early warning.

The Navy has two atomic-powered submarines with the fleet—the U.S.S. Nautilus, commissioned in 1954, and the U.S.S. Sea Wolf, launched in 1955.

A special effort will be made in the immediate future to increase the number of shipyards capable of designing and building atomic submarines.

The new attack submarine will be an improved version of another atom-powered submarine now under construction.

Two additional atomic submarines, which are part of Navy's current fiscal year program, will be built at the Mare Island and Portsmouth Naval shipyards. Both will be attack-type vessels.

Comes now word that the Navy is ready to ask for funds for an atomic-powered aircraft carrier in fiscal 1957. It will be the first of its kind in the world. Different in design from the Forrestal, the Navy disclosed the projected warship will be 85,000 tons and about 1,000 feet in length. The Forrestal is 60,000 tons but 1,083 feet long. The additional displacement will result from the increased weight of the reactors. There will be a small island and a comparatively small stack. It is also reported that the new carrier will mount guided missiles.

Army Reserve Program

Wilber M. Brucker, Secretary of the Army, declared that the Army is determined to make a success of the new 6-month Reserve program on the voluntary basis prescribed by Congress.

Congress placed the 6-month training program entirely on a voluntary basis despite counterpleas that compulsory features and power to draft youths into the program were necessary to achieve success. The program got off to a slow start last October, with only 1,167 men reporting to 5 training centers.

Mr. Brucker has no intentions of asking Congress for compulsory provisions.

"There are going to be no 'if's' about this program," he said. "This program is going to be predicated upon its being successful, and we are reasonably resolved that it will be. I have not come to the place where I believe that in this country of 160,000,000 people there aren't literally tens of thousands of young men who are willing to volunteer to do their part to ready themselves for military training of this kind.

"The Army is going to proceed upon the principle that this can be done. There's going to be no sulking about it."

Mr. Brucker reported a total of 4,224 enlistments under the Reserve Forces Act of 1955, broken down as follows:

First, 2,718 youths enlisted in units of the U. S. Army Reserve. Of these, 1,673 are high-school students who will not have to take their 6 months of training until they have graduated, or reached the age of 20, whichever comes first. The other 1,045 in this group signed up for immediate training. This group will spend 7½ years in the Inactive Reserve.

Secondly, 1,353 signed up for a total Reserve obligation of 6 years, which includes two years of active duty.

Thirdly, 153 who had prior service enlisted for one full year of active duty. This will enable them to complete whatever Reserve obligation remains in the stand-by rather than the ready Reserve.

Mr. Brucker is hopeful the Army will get the quota of 90,000 youths for the 6-month program by the end of the current fiscal year, June 30, 1956.

Automation vs. Red Tape

The Army has devised a way to assign replacements to overseas units with punch-card machines. The system is expected to eliminate the need for soldiers bound for Europe to stop for processing and assignment at replacement depots.

According to present plans, the Overseas Replacement Station at Fort Dix, N. J., will radio information from electronic punch-card machines to Army headquarters at Heidelberg, Germany.

The European headquarters will use the information to determine assignments and relay them back to Fort Dix. This will enable soldiers to report directly to their duty stations in Europe.

The Army claims that the new system should save travel time, administrative work, and transportation costs.

On another sector of the red-tape gobbledegook front, a special Budget Bureau advisory board appealed to businessmen to make suggestions for improving and simplifying Government forms for statistical or other information. Businessmen will apply the following three tests in suggesting improvements:

1. Is the information readily available, or would it be more easily available if the inquiry were modified in form?

2. Does it appear to duplicate other Government requests?

3. Are the uses to which the information is to apply obscure or inappropriate on the basis of the respondent's knowledge of the type of data that can be supplied?

The former Commission on Organization of the Executive Branch of Government, headed by former President Herbert Hoover, identified 4,700 forms or questionnaires "imposed upon private citizens or business concerns." It said its task force had tried an experiment with only 328 of these.

In 75 cases, involving 32 Government agencies, improvements were brought about representing an estimated annual saving of $5,091,800 to the Government and $10,183,000 to industry, according to the Hoover report.

Businessmen are expected to accept the Government's invitation to help in slashing red tape with maximum alacrity. Maybe electronic punch cards will help!

Single Manager Program

A sharp conflict of opinion has arisen over a suitable system for the distribution and management of common-use commercial-type items in the military services.

The Department of Defense solution of this knotty problem is the Single Manager Commodity Assignment Program. Thus in the future all food items for all services will be under the jurisdiction of the Secretary of the Army who is designated as the single manager for this commodity area.

The assignment encompasses the entire supply field, from research and development through issue or disposal, including cataloging, standardization, requirements determination, procurement, production, inspection, storage, distribution, transportation, and maintenance.

According to Department of Defense spokesmen, the new program provides centralized control, eliminates duplication, makes interservice supply automatic, and ensures the effective utilization of stocks, services, and necessary facilities.

The new Department of Defense program is under fire from the Chamber of Commerce of the United States which has asked Defense Secretary Wilson to adopt the Hoover Commission recommendations establishing civilian control over the business aspects of supply and service activities of the armed forces.

The Chamber endorsed the Hoover recommendation for a single civilian agency, directly responsible to the Secretary of Defense, to manage the procurement, storage, and distribution of items used by all three armed services, such as food, clothing, fuel, and medical supplies.

The Chamber said the single-manager plan, as a substitute for the Hoover program, is "doomed to failure." The business organization pointed out that the Defense Department plan would set up "a multiplicity of separate organizations (single managers) within the military departments" which are already "so complex and unwieldy."

The Defense Department plan, according to the Chamber, represents "nothing more than another attempt to attain through compromise and patchwork an objective which can be achieved only through a more courageous approach to the problem."

The overriding virtue of the Hoover plan, the Chamber said, is that it would make possible the necessary degree of coördination and integration of supply activities, thus eliminating interservice jealousies which lead to confusion and waste.

The Defense Department has crossed the Rubicon by assigning jurisdiction over food for all services to the Army. The actual operation of the plan will be carefully studied and the results reported in due course.

There remains, however you look at it, the ironclad fact proved by history from the beginning that the fighter on land, sea, and in the air must control his own destiny in battle. And no one except the fighting man in uniform—under constitutional civilian control—can be asked to win victory if he does not have complete authority and responsibility for the essentials of his life—his food, his fuel, his raiment, his health, and his weapons!

Peacetime Rockets

Mail and special cargo will be sent, in a few years, from New York to San Francisco in an hour or less with rockets!

Jet planes to be delivered in 1960 may be as obsolete for certain aspects of intercontinental flight as the jet is making the piston-engined airplane obsolescent!!

Harry F. Guggenheim, a national leader in the jet propulsion field, recently presented the basis of these interesting forecasts to the American Rocket Society:

"The new jet planes with speeds of 500 to 600 miles per hour must compete with rockets flying 3,000 miles or over per hour. The cost of operation and construction of jet planes for mail and special cargo will be prohibitive compared with that of the rocket.

"Why, for example, pay for the cost of fuel for transporting each pound of mail by airplane a distance of 5,000 miles when by rocket you only have to pay for the cost of fuel for a distance of, say, 90 miles—60 up to altitude and maybe 30 or more decelerating on the way down? For the rest of the 5,000 miles you can coast along in the ionosphere without fuel."

As an added argument, Mr. Guggenheim remarked that the cost of a mail-carrying rocket "should be only a fractional part of that of the modern jet passenger carrier." Could it be that the current increase in mail rates will be countermanded by rocketry? If so, it would be but one more proof that armament progress effects directly the advancements of peace!

The Price of Peace

An Editorial

THE recent collapse of the Geneva Conference, in which the foreign ministers of the United States, Britain, France, and the Soviet Union participated, is somewhat discouraging but not unexpected. No agreement was reached on disarmament, which had second place on the agenda.

All four delegations agreed on the need for disarmament in both nuclear and orthodox fields. But they could not agree on the methods whereby this goal could be attained.

The Soviet Union called for vague moral pledges against war and for disarmament. The Western powers said that practical and workable controls and inspection should come first. What now?

No progress has been made by diplomacy that is visible to the naked eye. For us the only remaining alternative is that we keep our national-defense strength equal to all the tasks we have assumed around the world. These commitments are not only global in character but substantial in detail.

Our position was well expressed recently by Whitley C. Collins, president of Northrop Aircraft. Mr. Collins' major thesis was that the character of future war makes it imperative that our country be well armed until there is no longer any threat of conflict. He warned that in the two previous major wars the productive capacity of American industry had swung the balance. The next time, however, "war's new character makes possible the sudden death of nations"—a direct reference to the new atomic and hydrogen weapons.

"This means," Mr. Collins said, "that if we ever fight again, we will do it with a club that we have in our hand at the time war breaks out."

ACCORDING to Charles E. Wilson, Secretary of Defense, the failure of the Geneva Conference will have little or no impact on our defense program. There has been some speculation in Washington that the failure to reach any tangible agreements at Geneva might cause a spurt in defense production.

Mr. Wilson quieted these speculations by reaffirming his intention of maintaining defense spending for the fiscal years 1956 and 1957 at the estimated level of $35,000,000,000. Defense spending will have to be accelerated. There are authentic indications that it will be!

These observations lead us immediately to the heart of the matter, to the core and mainspring of current government policy that seems, at first glance, to express a blatant contradiction.

We talk disarmament, but defense spending continues in high gear. Are we guilty of some clever double-talk? Is it possible to reconcile the armament-disarmament paradox?

First of all, we have the evidence of American intent in President Eisenhower's proposals in which our government expressed its firm determination to keep disarmament on the agenda of future conversations. The crack-up of the Geneva spirit does not in the least alter our desire to work out a mutually satisfactory agreement with the Soviet Union.

In recent months Harold E. Stassen, Special Assistant to the President for Disarmament, has asked a number of distinguished Army-Navy-Air officers to help him in his task of getting the facts concerning a possible limitation of armaments.

Chairman of the group will be Lieut. Gen. James H. Doolittle. Vice Adm. Oswald S. Colclough will represent the Navy, while Gen. Walter B. Smith will direct the Army advisory group. The high character and rich experience of these world-famous air-naval-military experts is a sure guarantee of the integrity and utter seriousness of our disarmament intentions.

IN specific terms, we are willing to discuss aërial inspection of military bases in our own country, provided that other countries will consent to the aërial inspection of their homeland bases. We are also willing to discuss aërial inspection of our bases overseas, provided other powers will consent to the aërial inspection of the forces beyond their frontiers.

The purpose of this mutual inspection program is to prevent a massive surprise attack by one power on another, but thus far none of these devices has been agreed upon.

Under these obdurate circumstances we have no other alternative but to continue our defense preparations according to schedule. Our basic philosophy in this vital matter has been well expressed by the Hon. Donald A. Quarles, Secretary of the Air Force.

"The road to peace and disarmament," he said, "is long and tortuous. Meanwhile we must maintain our strength at the ready. In fact, the best likelihood for continued world peace is our maintenance of a truly decisive air force—a condition under which an aggressor will know beyond the shadow of a doubt that we possess the certain capability of destroying him if he should attack us.

"If the potential aggressor should acquire the capability to launch a destructive atomic attack," Mr. Quarles added, "we would be no less secure so long as we maintain the power to retaliate decisively. This proposition creates a stalemate through deterrent strength, which I believe is, paradoxically, our best hope of peace."

WE are willing to disarm if all other powers will disarm. By remaining strong, until a mutually satisfactory program is worked out, we are making an effective contribution to world peace. Peace by paradox is not a new idea. Centuries ago it was expressed in the motto of the Artillery Company of London: "Arms are the props of peace."

And, centuries before that, Tacitus wrote: "The peace of nations cannot be secured without arms, nor arms without pay, nor pay without taxes."

ASSOCIATION AFFAIRS

Cleveland Post Honors Secretary of the Treasury George M. Humphrey

The Cleveland Post honored Secretary of the Treasury George M. Humphrey, a Clevelander and former president of the M. A. Hanna Company, at its annual dinner on Monday, November 7, 1955. Also honored was Vice Adm. George F. Hussey, Jr., president of the American Ordnance Association, who delivered the principal address. More than 600 members and guests attended the affair, held in the grand ballroom of the Hotel Statler.

Among the distinguished guests at the speakers' table were the Hon. Frank J. Lausche, Governor of the State of Ohio; Hon. George H. Bender, United States Senator from Ohio; Hon. Anthony J. Celebrezze, Mayor of Cleveland; and Hon. H. Chapman Rose, Under Secretary of the Treasury.

To Secretary Humphrey went the Association's General Benedict Crowell Gold Medal for distinguished service in behalf of the security of the Nation and the peace of the world. Presenting the medal to Mr. Humphrey was Albert J. Weatherhead, Jr., president of the Weatherhead Company and president of the Cleveland Post. The accompanying citation read in part:

"George M. Humphrey, Clevelander, lawyer, industrialist, statesman, and humanitarian, at a time when most men rightfully contemplate a lightening of their executive burdens, willingly accepted the complex responsibilities of one of the country's highest offices and has performed the duties thereof with brilliance, grace, and a profound sense of the dignity of man. In presenting this symbol of our admiration and affection, we salute one of the great men of our times—a fellow citizen of whom the entire Nation is proud."

In accepting the Crowell Medal, Mr. Humphrey declared: "A sound monetary system is essential to the incentive system which makes America a free country. A poor financial structure would depreciate values and destroy incentive on one hand as surely as high taxes would do it on the other."

Governor Lausche stated that in his opinion Mr. Humphrey would go down in history as one of the great Secretaries of the Treasury. Mayor Celebrezze issued a proclamation making Monday, November 7th, "George M. Humphrey Day."

The invocation was pronounced by Maj. Thurman H. Tobias, chaplain of the 37th Infantry Division, Ohio National Guard. J. E. Trainer, executive vice-president of the Firestone Tire & Rubber Company, Akron, and vice-president of the Cleveland Post, introduced Admiral Hussey who discussed "The Present Day Aims and Needs of the American Ordnance Association." He described the workings of the Association and the support which its 38,000 members render to the ordnance facilities of the Government.

At Cleveland Post dinner were, left to right facing camera, A. J. Weatherhead, Jr., Post president; Maj. J. W. Beckett, chief, Cleveland District, U.S.M.C.; Secretary of the Treasury George M. Humphrey; Hon. Frank J. Lausche, Governor of Ohio; Capt. N. S. Gilchrist, U. S. Navy; Hon. A. J. Celebrezze, Mayor of Cleveland; Vice Adm. George F. Hussey, Jr. (partially hidden), A.O.A. president; Rear Adm. Frank A. Leamy, 9th District, U. S. Coast Guard; and J. E. Trainer, vice-president of the Cleveland Post. More than 600 members and guests attended the affair.

• **AT DALLAS.**—The Lone Star Post held its fall meeting at the Baker Hotel on September 27, 1955. There was a large crowd on hand led by Post President I. N. Palley to welcome the guest of honor, Vice Adm. A. K. Doyle, Commander of the Naval Air Training Command.

After a reception and dinner in the Terrace Room, Admiral Doyle spoke on "Future Development of Naval Air Defense." The Admiral pointed out that although the Navy's mission, command of the sea, has not changed, the necessary weapons are undergoing constant development.

The Admiral told of the Navy's latest underwater ordnance and forecast ever-improving power of our carrier striking forces soon to be implemented with guided-missile cruisers as well as faster and longer-range aircraft.

• **AT ALBUQUERQUE.**—The A.O.A. members in the Albuquerque area have enjoyed a tremendous growth since the Chapter was formed as a part of the Rocky Mountain Post. Under the able leadership of Col. C. F. H. Begg, Chapter president, Rear Adm. W. W. Juvenal, L. E. Snodgrass, and many other enthusiastic ordnancemen, membership has soared from the original 40 to over 150 and continues to climb.

The Albuquerque Chapter was officially designated the newest Post of the Association, effective November 1, 1955. After several months of continuous effort a petition with more than the required 100 signatures was forwarded to A.O.A. headquarters at Washington. The officers and directors of the Chapter are officiating in the Post until elections are held at the next meeting.

The last meeting of members as a Chapter was held on October 6, 1955, with a dinner at the Kirtland Air Force Base Club. The principal speaker was Col. A. W. Carney, chief of the Technical Operations Division, Air Force Special Weapons Center, Kirtland Air Force Base, who presented a most impressive talk on "National Policy and Air Force Strategy."

• **AT ST. LOUIS.**—The local Post sponsored an informal afternoon meeting of industrial representatives and armed forces mobilization planners at the Park Plaza Hotel, St. Louis, on October 7, 1955.

The Army, Navy, and Air Force were represented respectively by Col. William A. Evans, deputy chief of the St. Louis Ordnance District; Comdr. L. T. Woodard, commanding officer, Naval Air Training Station, Lambert Field, St. Louis; and Col. Paul G. Dolan, head of the St. Louis Air Force Procurement Office. Colonels Evans and Dolan reported on the efforts expended by their offices in connection with mobilization planning and their layaway plans and presented the current procurement picture in their area.

The meeting adjourned at 5:30 p.m. after a question-and-answer period following the presentations.

• **AT PORT CLINTON, OHIO.**—The Michigan Post turned out 400 strong for a day of demonstrations and exhibits at the Erie Ordnance Depot on October 12, 1955.

The members arrived by train in the forenoon in time to inspect the shops and storage area of the depot where the proof inspection and packaging of ordnance equipment were of special interest. At luncheon, Post President James K. Fulks welcomed the crowd and spoke briefly on the importance of close industry-ordnance relations as evidenced by the Post meeting.

On the firing front the depot personnel demonstrated the entire family of weapons including a large fieldpiece that lobbed shells fourteen miles out into Lake Erie. Most interesting among the weapons was a rapid-fire aircraft cannon developed by Ford Motor Company and now in production at the Pontiac Division of General Motors Corporation.

The return trip enabled many old friends to assemble for discussions during the refreshment hour where they were in highest praise of the excellent program arranged by Col. Elmer W. Krubbs, commanding officer of Erie Ordnance Depot, and his personnel.

• **AT SCHENECTADY.**—The Capital Cities Post met at the Edison Club on October 10, 1955, for the first gathering of the season. Prior to the dinner meeting the members and guests toured the General Electric Atomic Laboratory, "The Knolls," where they saw the application of many sciences and the wide variations of equipment needed in the development of nuclear plants for power and propulsion. It was an impressive array of the paraphernalia required to utilize nuclear energy for peacetime uses.

After a reception and dinner the presiding officer, E. D. Doherty, Post president, introduced Dr. C. G. Suits, vice-president and director of research, General Electric Company. Dr. Suits gave an excellent up-to-the-minute talk on the relationship between industrial research and the national defense.

New York Post Visits Military Academy, Also Holds Dinner for Life Members

New York Post members enjoyed the hospitality of the Military Academy at West Point on Saturday, September 25, 1955. Lieut. Gen. Blackshear M. Bryan is Superintendent of the Academy.

Under the leadership of Maj. Gen. R. L. Maxwell, Post president, over 900, including members, their families and friends, journeyed to West Point by bus where in the forenoon they were treated to a tour of the points of interest under the guidance of officers of the West Point staff.

Maj. Gen. Russell L. Maxwell, left, president of the New York Post, visits with Lieut. Gen. Blackshear M. Bryan, Superintendent of the U. S. Military Academy.

After luncheon at Smith Rink the party viewed the Cadet Corps on parade and proceeded to Michie Stadium to watch West Point's opening football game. Here the Black Knights of the Hudson showed their great power in swamping Furman University of South Carolina.

On September 27th, under the chairmanship of General Maxwell, a reception and dinner for life members of the Post were held at the Sheraton-Astor Hotel, New York City.

The senior officers of the Ordnance Corps of the Army, headed by Maj. Gen. Emerson L. Cummings, Chief of Ordnance, who were assembled in New York at the time for the semiannual conference of the Ordnance district chiefs, also attended as guests of the Post. The address of the evening was delivered by Maj. Gen. John Bruce Medaris, Assistant Chief of Ordnance.

Seated with General Maxwell at the head table at the dinner in addition to Generals Cummings and Medaris were the following: Vice Adm. George F. Hussey, Jr., president, American Ordnance Association; Maj. Gen. E. P. Mechling, commander, Air Force Armament Center, Eglin Air Force Base; Brig. Gen. Norman F. Ramsey, former commanding general of Picatinny and Rock Island Arsenals; Col. E. F. McCrossin, chief, New York Ordnance District; Col. Joseph A. Petrolino, Ordnance Officer, First Army; Joseph L. Auer, vice-president, New York Post; James D. Maitland, president, Rocky Mountain (Denver) Post; Henry T. Luria, vice-president, New York Post; Lloyd W. Stearns, director, New York Post; Col. Leo A. Codd, executive vice-president, American Ordnance Association, Washington, D. C.

• **AT EGLIN AIR FORCE BASE.**—The first meeting of the season for the Florida Post was conducted as Valparaiso, Fla., on October 12, 1955.

C. R. Briggs, manager, Administrative Department, Scientific Laboratory, Ford Motor Company, the guest speaker, outlined the major elements of research in his organization. His talk was skillfully implemented with a 20-minute film showing the phases of fundamental research undertaken at the Ford Scientific Laboratory.

• **AT LOS ANGELES.**—Members of the Los Angeles Post with Vice Adm. George F. Hussey, Jr., national president of the A.O.A., as guest of honor, joined other men of industry in Southern California and officers of the armed services to visit the Firestone Tire & Rubber Company plant at Los Angeles on October 14th. Under the guidance of Leonard K. Firestone, the party toured the manufacturing and assembly shops of the plant, concentrating on the area where this company is assembling and packaging the Corporal missile.

Following this interesting visit the members adjourned to the California Club for dinner where R. C. Geffs, Post president, presided and Admiral Hussey spoke briefly on the American Ordnance Association and discussed the field of standardization in the guided missile production program.

• **AT BINGHAMTON, N. Y.**—The Tri-Cities Chapter of the Empire Post opened its season with a dinner meeting on October 27, 1955, at the American Legion Club House. Over sixty members were on hand to welcome Lieut. Col. Harold T. Neal of the Plans and Programs Division, Rome Air Development Center, Griffiss Air Force Base. The guest of honor was introduced by John H. Bouman, Chapter chairman.

Colonel Neal chose for the subject of his remarks "What Industry Should Expect from the Government Research and Development Agencies and What Government Expects from Industry." He pointed to the essential combination of qualified scientific manpower in industry with the large funds available in the Defense Department as the bright hope for keeping our armament up to date.

It was an excellent address from an officer who has had great experience in the field and was found extremely interesting and instructive by all the members present.

At San Francisco Post meeting were, left to right: Brig. Gen. L. J. Rumaggi, Sixth Army; Maj. Gen. R. H. Pepper, U.S.M.C., Pacific; Lieut. Gen. E. R. Quesada, U.S.A.F., Ret.; Brig. Gen. Monro MacCloskey, U.S.A.F., 28th Air Division; Vice Adm. F. S. Low, U.S.N., Western Sea Frontier; and L. S. Fletcher, San Francisco Post president.

San Francisco Post Hears Talk on Missiles by Lieut. Gen. E. R. Quesada

The San Francisco Post held its fall luncheon meeting at the Fairmont Hotel on November 3rd. Over 300 members and guests assembled to welcome the guest of honor, Lieut. Gen. E. R. Quesada, U.S.A.F., Ret.

Post President Lawrence S. Fletcher presided at the meeting in the hotel's Venetian Room. He introduced General Quesada, a veteran Air Force officer, to the audience which included top-ranking military officials and industrial leaders.

General Quesada in his talk on "Today and Tomorrow in Missiles" warned against sacrificing reliability of the Nation's weapons on the altar of the "almighty dollar."

"It is terrible to engage the enemy in combat and have your weapons fail," he recalled from his twenty-seven years of experience with the Air Force. "We must be more than casually conscious about the element of reliability; it is the most important element of development today."

General Quesada termed missiles not fantastic but weapons accepted as a normal element of our national-defense inventory today. Tomorrow's weapons will be vastly more complex, he said.

He urged Americans to examine their production of scientific genius in the light of America's needs and said we had no reason to copy the Soviet system of pro-

PRAYER FOR ORDNANCEMEN

"Great Creator, who raised this land between two oceans and then, for centuries after the birth of man, hid it from human eyes, help us to appreciate those who finally came to see and value it, not for its gold and hides, not for its crops, not as a dumping ground for human misfits, but rather as a stable home for those who would live for an ennobling freedom.

"Life, liberty, and the pursuit of happiness are goals worthy of the most exalted human endeavor, but they are achieved only by those of virtuous character, who see with clarity that which is nigh and that which is still afar off. Endue us with a sound purpose. Graft in our hearts a love of the truth. Establish our moral and spiritual convictions on attitudes that have been tested in the balances of time and not found wanting.

"When there is manifest a tendency to humor ideas that are outmoded and appropriate methods that enslave, may we be awakened by the lessons of the past. Strengthen our spiritual backbones that we may stand, as individuals and as a nation, erect and honest and unafraid. Support us in the practice of a fine integrity and a patient fortitude, as those who shy at no hard task or evade a difficult assignment. Emancipate us from irresponsible attitudes and actions that fetter. Vouchsafe to us a firm grasp of the right and the vigilance and dauntless courage to defend it.

"Inspire us to seek, above all else, Thy honor and glory. Fashion us into a people glad to do Thy will. Then, at long last, may we, in some humble way, merit the mark of Thy approval. Through Jesus Christ our Lord. Amen."—The Very Rev. N. R. H. Moor, *Dean of Trinity Cathedral, Pittsburgh, at Pittsburgh Post Meeting, November 21, 1955.*

ducing scientists. He lauded American big business for spending millions yearly on developing the reservoir of scientific knowledge and suggested that little business could lend a hand.

Other Post officials and guests at the speakers' table included: Lieut. Gen. LeRoy Lutes, vice-president, Mansfield Tire & Rubber Company, Oakland, Calif.; J. M. Hait, vice-president, Food Machinery & Chemical Corporation, San Jose, Calif.; Brig. Gen. L. J. Rumaggi, chief of staff, Headquarters, Sixth Army; B. C. Heacock, chief, San Francisco Ordnance District; Vice Adm. F. S. Low, Commander, Western Sea Frontier, U. S. Naval Base, Treasure Island, Calif.; A. B. Layton, vice-president, Crown-Zellerbach Corporation, San Francisco; Dean Witter, Dean Witter and Company, San Francisco.

Also at the speakers' table were: Maj. Gen. R. H. Pepper, Commanding General, Department of the Pacific, U. S. Marine Corps; Norman R. Sutherland, president, Pacific Gas & Electric Company, San Francisco; Brig. Gen. Monro MacCloskey, commanding the 28th Air Division (Defense), Hamilton Air Force Base, Calif.; William E. Butts, president, General Metals Corporation, San Francisco; and Col. Calvin A. Heath, Commanding officer, San Francisco Ordnance District.

Five Hundred Members and Guests Hear General Bolte Address Pittsburgh Post

An array of industrial and military talent, unsurpassed in the annals of the Ordnance Association, was present at Pittsburgh on November 21, 1955, when Gen. Charles L. Bolte, ACF Industries, Inc., addressed the Pittsburgh Post on "The Contribution of American Industry to the Armed Forces." More than 500 leaders of the industrial community of the steel capital were on hand to greet the general and the other outstanding guests. William K. Fitch, president of the Post and chairman of Dravo Corporation, was chairman of the meeting.

Benjamin F. Fairless, chairman of the executive advisory committe, United States Steel Corporation, and a director of the Ordnance Association, was toastmaster. He paid glowing tribute to the importance of the work being done by the Association.

Vice Adm. George F. Hussey, Jr., president of the Association and managing director of the American Standards Association, presented greetings from the national organization and reported on the progress of the A.O.A., congratulating the Pittsburgh Post on its growth and operations. Admiral Hussey presented a scroll of appreciation to Alexander E. Walker, chairman of the board, National Supply Company, for his successful leadership of the Post during his tenure as president.

General Bolte described in telling phrases the importance of the Army General Staff and its contributions to stability in policy and management of military operations and plans. General Bolte was Vice Chief of Staff under Gen. Matthew B. Ridgway, who was present at the meeting and who was recently elected a director of the Pittsburgh Post.

The invocation at the meeting was given by the Very Rev. N. R. H. Moor, D.D., dean of Trinity Cathedral, Pittsburgh (see box on page 626).

Maj. William S. Rial, Jr., secretary of the Post, was in charge of the general arrangements and was congratulated on all sides for the perfection with which details of the huge gathering were carried out.

• **AT ROME, N. Y.**—Members of the Syracuse-Central New York Chapter of the Empire Post assembled at Griffiss Air Force Base for their annual meeting on November 15th. Through the courtesy of Brig. Gen. A. R. Maxwell, commander of the Rome Air Force Depot at the Air Force Base, the members assembled at the Officers' Club for dinner.

Presiding at the meeting was Paul L. Christensen, Chapter chairman, who called upon John L. Collins to present the nominations for officers and directors for the coming year. The nominations were unanimously accepted and included Brig. Gen. T. C. Rives of General Electric Company for president; William J. During of Precision Castings, Inc., first vice-president; Gustav F. Watters, Niagara Mohawk Power Corporation, second vice-president; and Gwyn Thomas, Manufacturers' Association of Syracuse, secretary-treasurer.

General Maxwell described the numerous activities that take place at Griffiss Air Force Base and then invited the members to adjourn to the alert hangars. Here he directed a simulated scramble of the F94C Starfires that showed the celerity with which this integral part of our air defenses can leap into action.

Secretary Brucker Is Guest of Honor at Meeting of the Washington Post

At their luncheon meeting on October 20, 1955, the Washington Post had as its guest of honor the Hon. Wilber M. Brucker, Secretary of the Army. The occasion was noteworthy also in that the members met for the first time at the Army-Navy Country Club in near-by Virginia.

After refreshments on the balcony overlooking the golf course and luncheon in the main dining room, about 250 members and guests gathered in the grand ballroom to greet Secretary Brucker. George M. Riveire, Post president, as presiding officer first called upon Paul Hickman to give the ceremonial reading of the preamble of the A.O.A. constitution. Mr. Riveire then introduced the distinguished guests and presented Secretary Brucker to the audience.

Mr. Brucker praised the important work of the American Ordnance Association in

At Washington Post luncheon were, left to right, Brig. Gen. J. P. Newberry, Assistant for Logistic Plans, U.S.A.F.; Vice Adm. Murray Royar, Chief of Naval Material; Secretary of the Army Wilber M. Brucker; G. M. Riveire, Post president; Assistant Defense Secretary T. P. Pike; Assistant Secretary of the Army Frank H. Higgins; and Maj. Gen. E. L. Cummings, Chief of Army Ordnance.

encouraging the close coöperation of industry and the ordnance activities of the armed services. He then warned against cutbacks in the ceaseless search for new and more effective weapons and at the same time pointed out that the Army would never drop its present weapons of proven worth for new weapons until they had been thoroughly tried.

Other distinguished guests at the speakers' table were the Hon. Thomas P. Pike, Assistant Secretary of Defense, Supply and Logistics; Hon. Frank H. Higgins, Assistant Secretary of the Army; Maj. Gen. E. L. Cummings, Chief of Army Ordnance; and Brig. Gen. James P. Newberry, U.S.A.F., Assistant for Logistic Plans.

The Washington Post had another memorable meeting at the Army-Navy Country Club in November. Dr. Frank K. Pittman, deputy director, Division of Civilian Application, Atomic Energy Commission, was the principal speaker. The large and enthusiastic audience in attendance taxed the facilities of the club.

Dr. Pittman spoke on current phases of the atomic-energy program with particular emphasis on power reactors and various applications in the agricultural, medicinal, and armament fields.

George Riveire, president of the Post, presided. On hand to meet members were other officers of the Post: Franklin B. Reybold, first vice-president, Alco Products, Inc.; W. J. Sears, second vice-president, Rubber Manufacturers' Association; and Stewart L. Magee, secretary-treasurer, United States Steel Corporation.

• **HARRY L. ERLICHER,** a member of the American Ordnance Association for many years and a past vice-president of the General Electric Company who has been serving his country recently as Special Assistant to the Secretary of the Army for Logistics, has relinquished his duties in Washington and returned to his home in Schenectady.

Although the Washington Post and A.O.A. headquarters will miss his cheerful coöperation and wise counsel, our members in the Capital Cities Post stand to gain as Mr. Erlicher has always been a staunch supporter in all the affairs of the A.O.A. All members of the Association in Washington will miss their energetic friend, but look forward to visiting with him in New York and wish him the greatest success for the future.

Members of the Yankee Post Hold All-Day Outing at Fort Devens, Mass.

The Yankee Post held an all-day outing and its annual fall meeting at Fort Devens, Mass. Members and guests arrived by bus at 12:30 p.m. for a tour of the area and inspection of many interesting exhibits including Nike missiles, recoilless rifles, mortars, and other types of weapons.

Yankee Post members inspect 4.2-inch mortar at Fort Devens, Mass., left to right: C. B. Weeks, Post president; Maj. Gen. E. B. Gjelsteen, commanding general, Fort Devens; J. S. Pfeil, chief, Boston Ordnance District; J. K. Ames, Portland, Me.; Gen. James McManmon, U.S.A.F., Ret.; Col. J. H. Martin, 74th Regimental Combat Team.

All hands then assembled to witness a live-weapons demonstration staged by the 74th Regimental Combat Team under the command of Col. J. H. Martin.

Over 300 members and guests then gathered at the Officers' Club where, after a reception and dinner, the result of the balloting for election of officers was announced by Post President Charles B. Weeks who then turned the chair over to the new president, M. Edgar Fain, a partner in Tower Iron Works of Providence, R. I. The new officers and directors are shown in the Annual Directory which accompanies this issue of ORDNANCE.

Mr. Fain then introduced the guest speaker, Lieut. Col. Thomas Gordon, Headquarters, Fort Devens. Colonel Gordon gave an especially interesting account of the activities and history of Fort Devens and described its close relationship and coöperation with the New England community.

Guests at the head table in addition to the new officers and directors were: Maj. Gen. E. B. Gjelsteen, commanding general, Fort Devens; John S. Pfeil, chief of the Boston Ordnance District; John K. Ames, Portland, Maine; Gen. James McManmon, Boston, U.S.A.F., Ret.; and Col. Julian H. Martin, commanding officer of the 74th Regimental Combat Team.

Quad Cities-Iowa Post Holds Meeting with Iowa-Illinois Chapter, A.S.M.E.

The Quad Cities-Iowa Post conducted its fall meeting at Rock Island Arsenal on October 14, 1955, jointly with the Iowa-Illinois Chapter of the American Society of Mechanical Engineers.

The early arrivals were treated to an inspection tour of the arsenal shops and a visit to the museum. After the reception and dinner, the meeting was called to order by the presiding officer, Maurice A. Fraher, Post president, who introduced Col. A. R. Cyr, commanding officer of Rock Island Arsenal.

In his welcoming address Colonel Cyr praised the work of the Post and noted that his personnel were extremely interested in the work of both the A.O.A. and the A.S.M.E. Paul Williams of the A.S.M.E. expressed his gratification over this joint meeting in celebration of Engineering Week.

Mr. Fraher outlined the American

Ordnance Association's program for 1956, including a campaign to emphasize emergency plant defense and civil defense. On the basis of a satisfactory report from the treasurer, it was agreed that the Post make a concerted effort to stress A.O.A. activities in the industrial cities outside of the Quad Cities area.

The principal speaker of the evening, Col. A. K. Sibley, spoke on "National Security in the Nuclear Age." In a simplified presentation of the physics of the atomic and hydrogen bombs, he emphasized the increased destructive power that makes it important to prepare effective defensive measures. He concluded with a plea for national vigilance and strength.

OVER 200 MEMBERS ATTEND TECHNICAL SESSION AND ANNUAL DINNER OF THE CINCINNATI POST, A.O.A.

The annual meeting of the Cincinnati Post on November 16th was one of the most successful ever conducted. The afternoon technical session devoted to discussions of nuclear problems was attended by over 200 members. Three excellent papers were presented. Col. Lennard C. Sorensen, deputy chief of the Cincinnati Ordnance District and secretary of the Cincinnati Post, acted as chairman, introduced the speakers, and monitored the discussion period.

Brig. Gen. J. A. Barclay, commanding general of Picatinny Arsenal, gave a complete analysis of the defense organization for nuclear activities with particular emphasis on ordnance participation.

Dr. C. Rogers McCullough, special atomic and nuclear projects, Monsanto Chemical Company, St. Louis, Mo., brought the audience up-to-date on the peacetime application of atomic energy.

H. E. Dodge, III, atomic power equipment department, General Electric Company, Schenectady, N. Y., discussed the subject, "Industry Accepts the Atomic Challenge."

At the evening dinner meeting in the Alms Hotel, John D. O'Brien, president of the Post, presided. The invocation was given by the Rev. George Connolly, Assistant for Catholic Charities, Diocese of Cincinnati. Brig. Gen. T. K. Vincent, staff consultant, national A.O.A. headquarters, read the preamble to the A.O.A. constitution according to the established custom followed at all A.O.A. Post and Chapter meetings.

After dinner the presiding officer introduced the guests at the speakers' table. Fred V. Geier, a director of the Cincinnati Post, read the citation accompanying the award of the Charles L. Harrison Medal to the guest of honor, Dr. Edward Teller. Harvey C. Knowles, national A.O.A. vice-president and a director of the Cincinnati Post, presented the medal.

Dr. Teller, professor of physics, University of California, the principal speaker at the dinner, responded to the award of the Harrison Medal in an excellent address on the general subject, "Science and Ordnance."

Empire Post Celebrates Ordnance Day at Rochester District Headquarters

Ordnance Day was celebrated by the Empire Post at Rochester, N. Y., on October 18, 1955. A.O.A. members from many parts of Western New York assembled there to discuss ordnance problems at Rochester Ordnance District headquarters' open house and to compete for the Post's golf trophy. About fifty members dropped by during the day to greet Col. E. G. Miller, deputy district chief, and to meet his personnel.

The golf tournament at Oak Hill Country Club was hotly contested and was finally won by Edward Howers of Bossert Corporation, Utica, N. Y.

At the annual dinner meeting in the evening, Maj. Gen. J. B. Medaris, Assistant Chief of Army Ordnance, shared the platform with Congressman Emanuel Celler, chairman of the House Judicial Committee. The meeting was held at the Oak Hill Country Club with a banner attendance of nearly 400 members and guests.

Congressman Celler presented his impressions of the European defense situation in the light of a recent visit to the principal countries in the NATO organization. He also stressed the importance of the work of the Ordnance Association through the years for the advancement of industrial preparedness.

General Medaris reviewed the relationship among the Ordnance Corps of the Army, American industry, and the Ordnance Association. His address was most timely in its analysis of problems concerning the Industry-Ordnance team.

Presiding at the meeting was Post President Ray C. Malvin, Houdaille-Hershey Company, Buffalo. The toastmaster was Claude G. Wright, vice-president, Page Airways, Inc. The invocation was given by the Rev. John A. Reddington, pastor, St. Louis Church, Pittsford, N. Y. Greetings were extended by the following: From the community, Capt. F. Dow Hamblin, U.S.N., Ret., executive director, Department of Public Works, City of Rochester; on behalf of Congress, Congressman Celler; from the Empire Post, Mr. Malvin; from the national Association, Col. Leo A. Codd.

Following a recommended procedure for national meetings of Posts, the preamble to the constitution of the Association was read by Colonel Miller, Post secretary. The benediction was pronounced by the Rev. Charles O. Harding, pastor, Church of The Master, Rochester.

At Empire Post dinner were, seated left to right: Capt. J. D. Shea, University of Rochester; Col. E. G. Miller, Post secretary; Maj. Gen. J. B. Medaris, Assistant Chief of Army Ordnance; R. C. Malvin, Post president. Standing, left to right: Col. A. S. Young, Air Matériel Command, Rochester; Rep. Emanuel Celler, Chairman, House Judicial Committee; Toastmaster C. G. Wright, vice-president, Page Airways.

HENRY N. MARSH AWARDED HIGHEST CIVILIAN HONOR BY DEFENSE DEPARTMENT

Henry N. Marsh, Deputy Assistant Secretary of the Army (Logistics), has been awarded the highest Department of Defense civilian honor by Secretary of the Army Wilber M. Brucker. The Department of Defense Certificate of Appreciation was presented in Secretary Brucker's office on October 17, 1955, in a ceremony attended by a large assembly of top-ranking military and civilian officials. The accompanying citation reads in part:

"He served as vice-chairman of a special NATO Task Force surveying production facilities in NATO countries and made important contributions toward furthering NATO production capabilities for propellants and explosives. As consultant to the Assistant Secretary of Defense for International Security Affairs he gave freely of his time, talents, and exceptional knowledge. . . . In all these activities he has been one of the best exponents of unselfish and generous civilian coöperation with our national defense in a highly specialized technical field in which he has few peers."

• **JOHN J. HYLAND**, founder and chairman of the board of the Control Instrument Company, Inc., died on November 11, 1955, at his home in New York City.

He had organized the company in 1934 with five employees and developed it to one of the Nation's key plants in the production of electronic instruments and office equipment. It was merged several years ago with the Burroughs Corporation but retained its identity.

When he organized the Control Instrument concern, Mr. Hyland became president, retaining the title until 1954, when he was elected chairman of the board. During his presidency Mr. Hyland invented or developed more than a dozen improvements in gunfire control, now used extensively by the Navy and Air Force. He also did work for foreign governments. In March 1947 the Navy Department's Chief of the Bureau of Ships awarded him a certificate of commendation for outstanding accomplishments during World War II.

In addition to membership in the American Ordnance Association which he supported loyally, Mr. Hyland held memberships in the Navy League of the United States, American Society of Naval Engineers, American Brazilian Association, and was on the president's committee of the University of Notre Dame.

Propellants and Explosives Committee Meets at the Naval Powder Factory

The Propellants and Explosives Committee met for a 2-day classified session at the Naval Powder Factory, Indian Head, Md., on October 20-21, 1955.

Chairman F. M. Hakenjos, Hercules Powder Company, Wilmington, Del., assisted by Deputy Chairman J. J. O'Neill, Olin Mathieson Chemical Corporation, East Alton, Ill., conducted the meeting.

Capt. George E. King, U.S.N., commanding officer, U. S. Naval Powder Factory, welcomed the Committee and briefly outlined the mission of his command. He was followed by Comdr. G. S. Foster, Jr. (S.C.), U.S.N., comptroller, who, by the use of charts, presented a very clear picture of the fiscal setup. A. G. Mayer and A. D. Wilroy, Jr., of the Powder Factory staff gave most interesting and factual talks regarding production.

Chairman Hakenjos described the work of the Committee, how it was organized, and the procedures by which rotation of membership was handled, so that new members could be added on a regular basis.

The discussion period covered several problems carried over from the 1954 meeting. These were concerned with black powder; nitroguanidine; flameout; applications of new explosives, such as PBX, HBX, MOX, Cyclotol and R Salt; status of work on HMX; and status of the program to evaluate the detonation hazard of propellant types in standard containers.

After luncheon, Henry N. Marsh, Deputy Assistant Secretary of the Army for Logistics; Duncan C. Smith, Ordnance Ammunition Command; and Col. John P. Harris, America Safety Razor Company, discussed the European production of military explosives and the status of the Facilities Assistance Program of the Office of the Secretary of the Army.

Col. George A. Miller, Frankford Arsenal, discussed the small-arms ammunition cook-off problem.

A refreshment hour at the officers' open mess was followed by an informal dinner at the Naval Powder Factory Hotel.

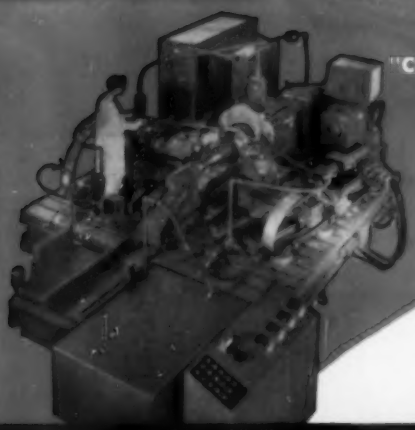
The second day's session covered new developments and programs including nitric-acid purification of TNT and usage of Triol, quality surveillance at the Naval Powder Factory, and the lead azides.

Under future process developments, the Army Ordnance production engineering program and the status of major production engineering projects under Ordnance Ammunition Command supervision were discussed.

The logistics problem which is always with us and the safety-quality-distance standards for mass-detonating explosives were commented upon. After luncheon the Committee was taken on a conducted tour of the Powder Factory.

The Committee elected Dr. W. F. Taylor of the Atlas Powder Company as its deputy chairman, to take office on July 1, 1956. At this time, Chairman F. M. Hakenjos will be relieved by Mr. O'Neill, the present deputy chairman. Succession in this manner is provided by the Committee by-laws, enabling the chairman to have at least one year's experience as deputy chairman before taking office. The by-laws provide also for replacing one-third of the members of the Committee each year.

At Propellants and Explosives Committee meeting, left to right: F. M. Hakenjos, chairman; Henry M. Marsh, Deputy Assistant Secretary of the Army; Brig. Gen. T. K. Vincent, A.O.A. staff consultant; and J. J. O'Neill, deputy chairman.



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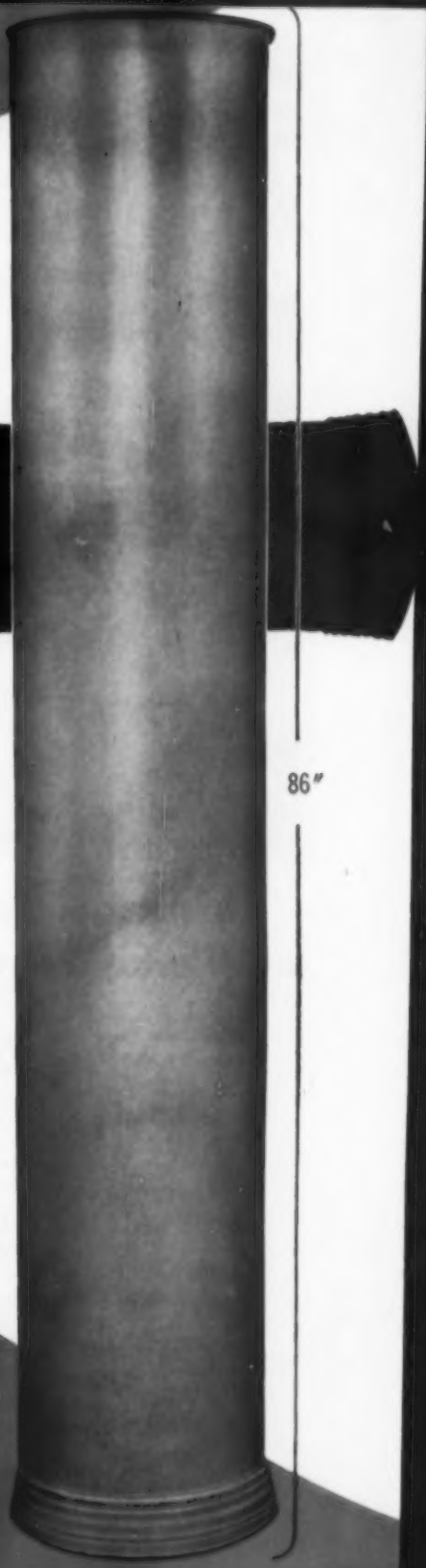

86"

JOB DATA: The blank is a billet-pierced, ring-rolled forging of annealed AISI 4140 aircraft quality steel, machined to 11" long x 13½" I.D. x ½" thick. The ring, slipped onto a straight, hardened mandrel, was *roll-formed* to the desired dimensions in less than 25 minutes (floor to floor time). "*Chipless machining*" by the Cincinnati Hydrospin reduced the wall thickness 92%. The finished tube is 86" long x 13.500" I.D. x 0.040" thick. Hardness increased to Rockwell C 39. Tensile strength after Hydrospinning is doubled. I.D. finish is 10 micro-inches and O.D. finish is 30 micro-inches or better.

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Divisions and Committees

FIRE CONTROL COMMITTEE, UNDERWATER ORDNANCE, MEETS AT GUN FACTORY

The Fire Control Committee, Underwater Ordnance Division, held a classified meeting at the Naval Gun Factory, Washington, D. C., on September 29, 1955, with Lewis W. Imm, chairman, presiding. This Committee has established a record of full attendance at all meetings to date.

The Committee is continuing to work on the problems connected with suggested procedures for records and communications and evaluation and testing procedures which were initiated at the New London meeting in July.

A subcommittee of this Committee is currently preparing a report of conclusions pertaining to records and communications and it has been suggested that the common interest in this problem indicates that the final answers should be coördinated with the other two Committees.

The Fire Control Committee joined with the Division for its meeting at the Naval Gun Factory on September 30th.

FIFTY MEMBERS ATTEND MEETING OF UNDERWATER ORDNANCE DIVISION AT WASHINGTON, D. C.

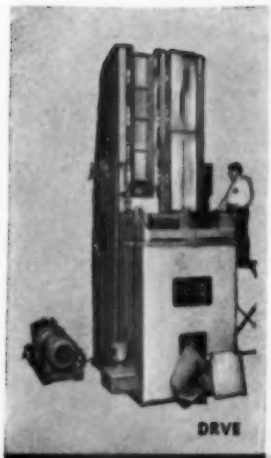
The Underwater Ordnance Division of the American Ordnance Association, met at the Naval Gun Factory, Washington, D. C., on September 30, 1955. Adm. A. G. Noble, chairman of the Division, presided. About fifty members attended.

During the meeting it was suggested (1) that Committee chairmanships be rotated, with the maximum length of service being two years; (2) that each Committee maintain a minimum of twelve members; (3) that Committee memberships be changed annually by replacing one-third of the members each year, and (4) that members who are absent from two consecutive meetings be replaced. The Division suspended action on these points until a later meeting.

Each of the chairmen of the Committees making up the Division reported briefly on the activities of his unit.

Capt. J. C. Atkeson, U.S.N., director of the Undersea Warfare Division, Office, Chief of Naval Operations, discussed the responsibilities and activities of his Division and the mutual benefits to be derived from industry-Navy activities, such as are furnished by the A.O.A. Underwater Ordnance Division.

Capt. R. D. Fusselman, U.S.N., head of the Undersea Warfare Research and



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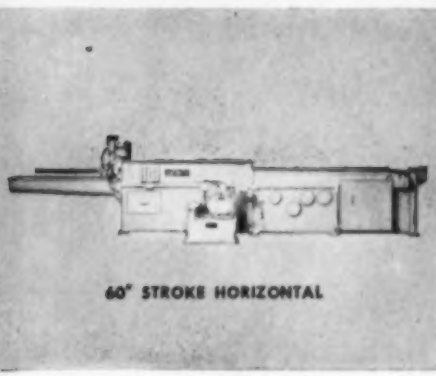

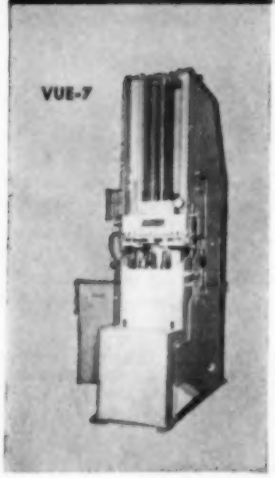

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Divisions and Committees

Development Branch, Undersea Warfare Division, Office of the Chief of Naval Operations, discussed briefly the operations of his office and promised further suggestions at future meetings.

An informal dinner was held on the evening of September 29th at the Naval Gun Factory Officers' Club, with Bureau of Ordnance representatives and the Naval Gun Factory commandant and his staff as guests of the Division and its Committees.

This Division, whose activities are wholly with the Navy, is one of the most active. It meets frequently, and very close coöperation between the Bureau of Ordnance and the industry members on the many technical phases of their activities is maintained.

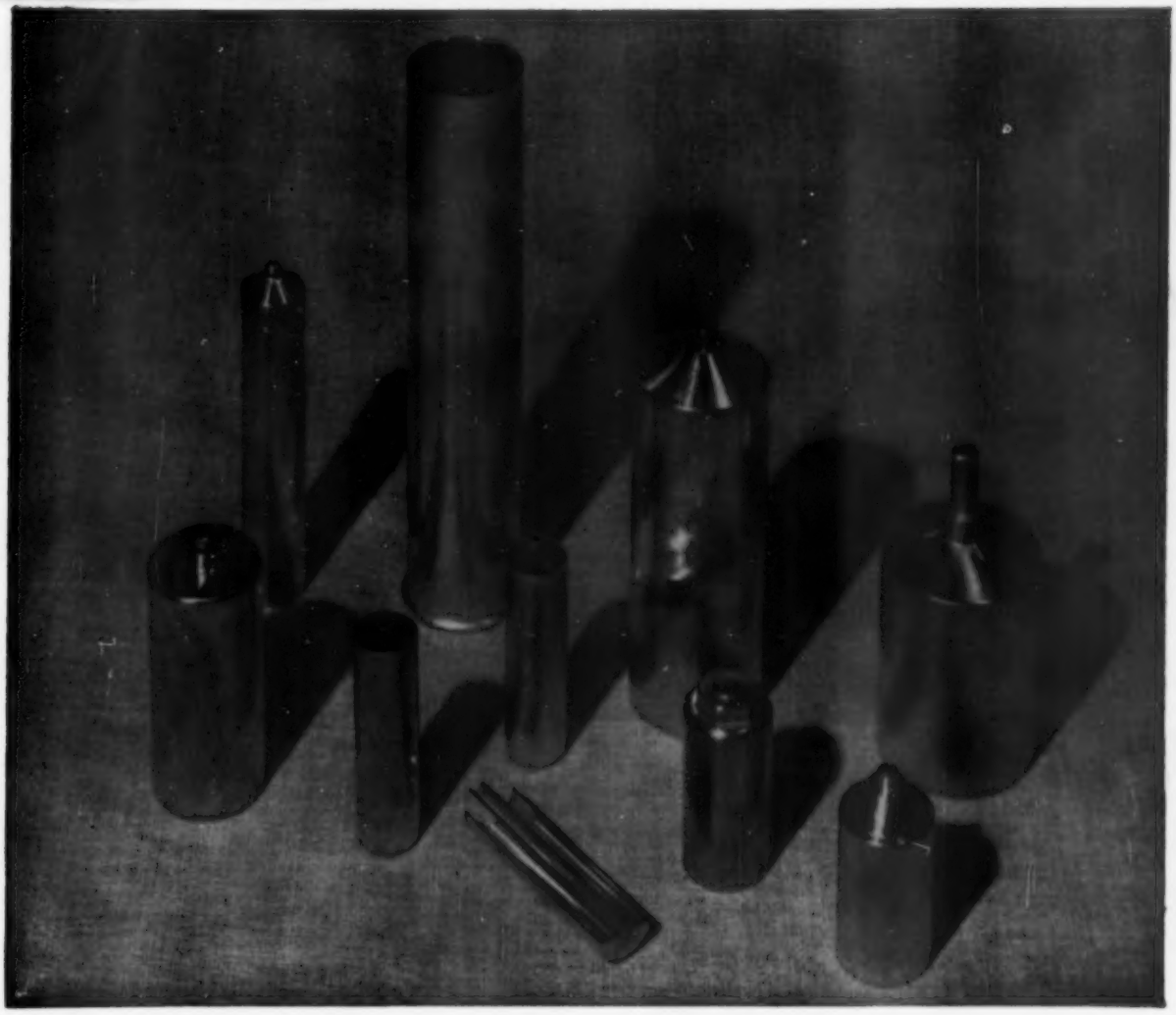
SURFACE PRESERVATION COMMITTEE HOLDS ITS SEVENTEENTH MEETING AT CHICAGO, ILL.

The seventeenth meeting of the Surface Preservation Committee was held at the Hotel Sheraton, Chicago, on October 11, 1955. Dr. G. W. Seagren is the chairman of the Committee, and Dr. Myron B. Diggin is secretary.

Lloyd Gilbert of Rock Island Arsenal discussed "Phosphate Coating Specifications." A. G. Tomasetti of Frankford Arsenal presented a report on "Progress in the Development of Organic Coatings for Small Arms Ammunition for Steel Cartridge Cases Specified in FA-PD-1808." Dr. C. F. Pickett, Aberdeen Proving Ground, discussed "Specification MIL-STD-171" on the painting of metal and wood surfaces and all preparations involved.

Harold F. Davison, Navy Bureau of Ordnance, reported on the status of the investigation of plastic inserts for the preservation of projectiles. Dr. Diggin gave a report on the status of insoluble anodes in electroplating, and T. G. Coyle commented on the thickness of plating. The improvements in the art of electroplating indicated that a revision in the specifications was in order and that steps should be taken to accomplish this. Dr. P. J. Rich discussed the progress being made in evaluating new types of sintered iron rotating bands.

The next meeting of the Surface Preservation Committee is scheduled for April 10, 1955, at the Sheraton-Cadillac Hotel in Detroit at which time it is proposed to discuss Teflon coatings, coatings to prevent premature cook-off, and JAN-P-450, among others.



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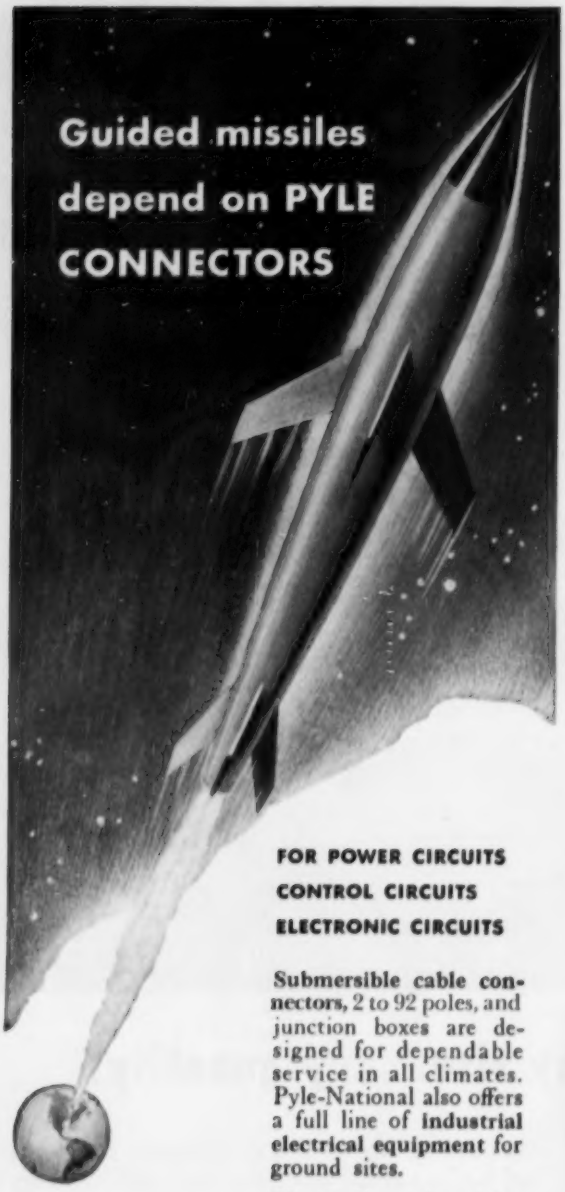

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Electronics Committee Holds First Meeting at Frankford

The Electronics Committee of the Fire Control Instrument Division, held its first formal meeting after its organization in June at the Frankford Arsenal on October 24, 1955. Dr. W. R. G. Baker, chairman of the Committee; Dr. J. W. McRae, deputy chairman; and Brig. Gen. T. C. Rives, secretary, were present and conducted the meeting. Representatives of the Navy and Air Force, as well as of the Signal Corps and Army Ordnance were present.

Brig. Gen. J. M. Colby, commanding general, Frankford Arsenal, welcomed the Committee and took an active part in the Committee's activities during the meeting.

Brig. Gen. T. K. Vincent represented national A.O.A. headquarters and spoke briefly of Association matters.

Dr. Baker opened the meeting by noting the growth of the Committee beyond all expectation. There are seventeen industrial firms represented among its sixty-seven members. The Committee has three active permanent subcommittees.

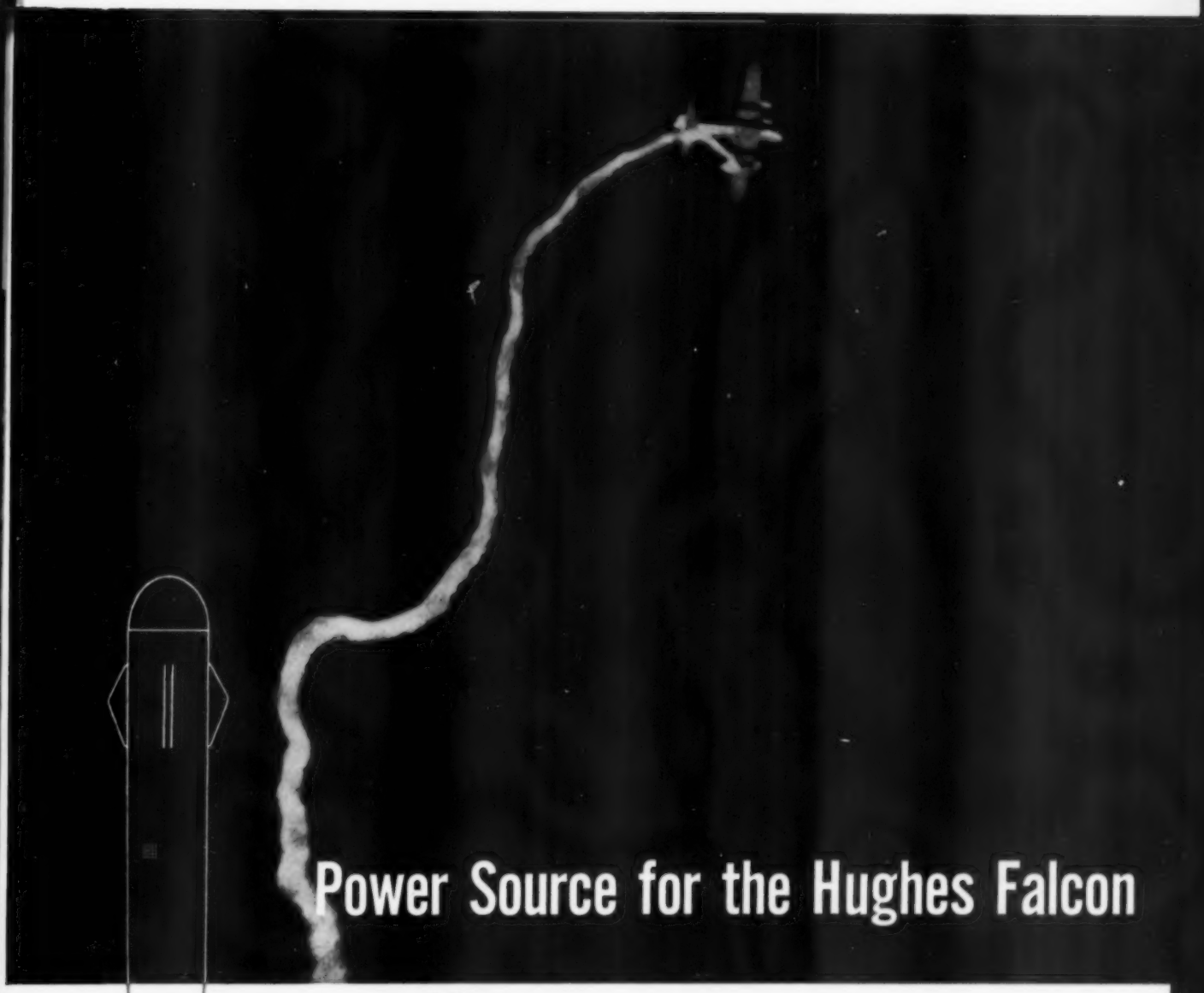
Col. H. C. Tuebner, chief, Fire Control Branch, Headquarters, Air Research and Development Command, discussed the Air Force-A.O.A. relationship and the work of the Electronics Committee in particular. He mentioned the effects of nuclear radiation on electronic components as an area to be explored by the Committee.

Henry Handler, Fire Control Section, Office, Chief of Army Ordnance, armed services coördinator to the Electronics Committee, covered the availability of data which would be of use to the Committee.

A. Rogers, Signal Corps Engineering Laboratories, discussed "Reliability" from the components viewpoint, raising the question as to the real need for extreme reliability in view of the price in time and money that must be paid for it.

Dr. Baker reported on a recent RETMA meeting where similar problems were discussed. There is need for a sensible definition of "reliability." The absence of close liaison between end-

The above group attended the meeting of the Fire Control Electronics Committee at Frankford Arsenal. In the first row, left to right, are: Brig. Gen. T. C. Rives, General Electric Company, Committee secretary; Dr. J. W. McRae, president, Sandia Corporation, Albuquerque, N. Mex., deputy chairman; Dr. Walter R. G. Baker, vice-president and general manager, General Electric Company, Syracuse, Committee chairman; Brig. Gen. Joseph M. Colby, commanding general, Frankford Arsenal; Brig. Gen. Thomas K. Vincent, A.O.A. staff consultant for Technical Divisions and Committees; and Gilbert W. Cain, Frankford Arsenal, adviser to the chairman of the Committee. The meeting was attended by military and civilian representatives from the electronics field to discuss the general problem of reliability of electronic equipment and the part the Committee can play in rendering service to the armed forces of the United States.



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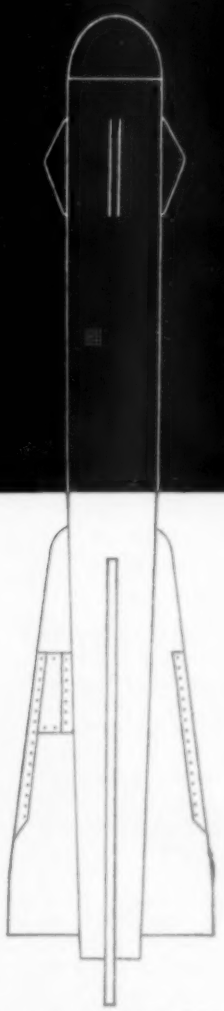

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item manufacturers and component manufacturers was responsible for much of the trouble. The confusion can only be straightened out by the military.

A general discussion followed in which it was brought out that all persons in the electronics field must be educated to the real needs. The procurement policy of the armed services is not attractive to manufacturers. Low-bidder awards are not compatible with reliability.

General Rives discussed the broadening of activities of the Electronics Committee, so that fire-control instrumentation was just a phase. The question of narrowing the field of the Committee to fire control or of broadening it to cover all electronics was raised. A vote was taken, and it was agreed to cover the broad field and explore the desirability of asking A.O.A. headquarters to establish the Committee as a separate Advisory Committee or Division. This was to be proposed in writing to the national officers for consideration.

The next meeting will be on the subject of "Reliability of Components" and will be held during the early part of February 1956 at an Air Force installation, probably the Air Force Armament Center, Eglin Field, Fla.

FIRE CONTROL INSTRUMENT DIVISION HOLDS ANNUAL MEETING AT ABERDEEN PROVING GROUND, MD.

The Fire Control Instrument Division held its annual meeting at the Aberdeen Proving Ground, Md., October 6, 1955. The meeting was classified and about 125 members were present. Col. Ralph L. Goetzenberger, chairman of the Division, presided.

In the absence of Maj. Gen. J. L. Holman, Brig. Gen. Joseph Horridge, acting commanding general of the proving ground, welcomed the group and expressed some very pertinent thoughts on the matter of the Fire Control Instrument Division, its field of activity, and the relationship to the Ordnance Training Command and its function of training the Ordnance soldier and civilian.

Brig. Gen. T. K. Vincent represented the national officers and directors of the A.O.A. and spoke briefly of affairs at national headquarters.

Colonel Goetzenberger outlined the policies and activities of the Division. Since the last annual meeting, the Electronics Committee had been formed and the Combat Vehicle Fire Control Committee, under the chairmanship of Col. Allen E. Gee, American Optical Company, was in the process of organization.

Dr. C. S. Draper, director, Department of Aëronautical Engineering and the Instrumentation Laboratory, Massachusetts Institute of Technology, discussed the fire control instrument problem from the Department of Defense level, with particular emphasis on its aëronautical aspects.

Maj. Gen. J. B. Medaris, Assistant Chief of Army Ordnance, spoke for the Ordnance Corps, Department of the Army. Brig. Gen. J. M. Colby, commanding general of Frankford Arsenal, presented the Army arsenal and command viewpoint. The Air Force was represented by Brig. Gen. L. I. Davis, USAF, commander, Holloman Air Development Center, and Lieut. Col. J. K. Sun, Air Armament Development Center, Eglin Air Force Base.

The Navy Bureau of Aëronautics was represented by Capt. T. A. Ahroon, U.S.N., director of the Armament Division. The Navy Bureau of Ordnance was covered by B. L. Schaub, fire control design engineer, Research and Development Division.

Brief reports were made by Brig. Gen. T. Rives, secretary of the Electronics Committee; by Thomas E. Rounds for the Instrument Precision Ball Bearing Committee; and by Hugh C. Carroll for the Proving Ground Instrumentation Committee.

After luncheon at the main officers' mess, the group enjoyed an interesting presentation at the Ballistics Research Laboratories under the direction of Col. A. R. Del Campo. The meeting concluded with a Development and Proof Services presentation at the Main Front under the direction of T. F. Colleran, director of D. & P. S.

TORPEDO COMMITTEE HOLDS CLASSIFIED MEETING AT VITRO LABORATORIES IN SILVER SPRING, MD.

The Torpedo Committee, Underwater Ordnance Division, under the chairmanship of Dr. G. R. Tatum, held a classified meeting on September 29, 1955, at the Vitro Laboratories, Silver Spring, Md.

The Committee has four panels making progress on four respective problems. These are: (1) An ad hoc panel under T. E. Lynch, studying standardization of torpedo workshop equipment, (2) an ad hoc panel under C. H. Godschall studying contamination of spare parts, (3) an ad hoc panel under M. E. Fagan, Jr., studying design disclosure, and (4) an ad hoc panel under A. M. Demont studying critical overhaul of torpedoes.

The Committee has received three additional problems, which are assigned as follows: (1) "Visual Tracking of Torpedoes," to an ad hoc panel under H. E. Oles, (2) "How To Make Adequate De-

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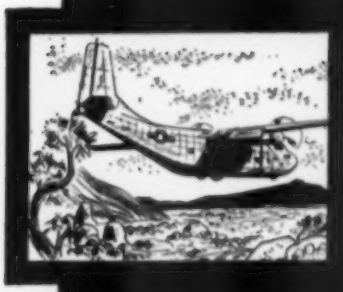

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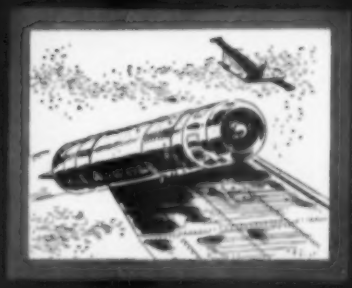

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Divisions and Committees

sign Disclosure on Lightweight Castings," to an ad hoc panel under F. G. Davis; and (*3*) "Production Coil Winding," to an ad hoc panel under L. L. Burke.

The Torpedo Committee attended the Division meeting on September 30, 1955, with the other Committees.

MINE COMMITTEE HOLDS CLASSIFIED MEETING AT NAVAL ORDNANCE LAB TO DISCUSS PROBLEMS

The Mine Committee, Underwater Ordnance Division, held a classified meeting at the Naval Ordnance Laboratory, White Oak, Silver Spring, Md., on September 29, 1955. J. McWilliams Stone, chairman, conducted the meeting.

The mine firing mechanism problem is progressing toward a solution, and coordination with the Naval Ordnance Laboratory was effected at this meeting. Three new problems—(1) design disclosure, (*2*) mine test equipment and standardization, and (*3*) procurement lead time—have been given to the Committee, and progress is reported.

F. D. Friedlein heads the subcommittee working on the design disclosure problem. H. L. Saums, is chairman of the subcommittee on test equipment and standardization. The procurement lead time problem has been deferred for action until a later date.

The Mine Committee joined the other Committees for the Division meeting on September 30, 1955.

SHELL COMMITTEE MEETS AT HOTEL DENNIS IN ATLANTIC CITY FOR CLASSIFIED DISCUSSIONS

The Shell Committee held its annual meeting at the Hotel Dennis, Atlantic City, N. J., on October 12-13, 1955. This year the meeting was classified "confidential." Chairman Walter N. Howley arranged a most instructive and interesting program. He announced the appointment of William M. Morsell, assistant director, Franklin Institute, as the permanent secretary of the Shell Committee.

After greetings from A.O.A. headquarters by Brig. Gen. T. K. Vincent, and remarks by Brig. Gen. J. M. Colby, Frankford Arsenal, and Brig. Gen. J. A. Barclay, Picatinny Arsenal, the chairman introduced C. L. Eksergian, chairman of the A.O.A. Guided Missile and Rocket Division; James D. Maitland, president of the Rocky Mountain Post; and Tom McCloskey, Navy Bureau of Ordnance, all

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Association Affairs

Divisions and Committees

of whom were guests at the meeting.

Fred S. Mallette, research manager, A.S.M.E., discussed plans being made for recording the present history of shell manufacturing so it will be available for use in the future.

Mr. Morsell discussed the organization and capabilities of the Franklin Institute as well as those of the other nonprofit research institutes and stressed the point that they "existed to perform service."

Capt. J. F. Byrne, U.S.N., commander of the Naval Proving Ground at Dahlgren, Va., in discussing the proving ground stated that ninety per cent of its work was concerned with research and development. At Dahlgren, testing activities were separated from evaluation of the results of tests so as to obtain unbiased conclusions and eliminate arguments.

Maj. Gen. J. B. Medaris, Assistant Chief of Army Ordnance, paid tribute to the A.O.A. Technical Committees and discussed classified matters of concern to the shell industry.

Capt. G. B. H. Stallings, U.S.N., chief of the Material Division, Navy Bureau of Ordnance, discussed the naval ordnance rôle in the shell activity.

After the official Committee luncheon, the chairman introduced the Hon. Frank H. Higgins, Assistant Secretary of the Army for Logistics. He discussed the assets of the Army, the abnormal turnover in top-level personnel, both military and civilian, and the reduction in the number of end items stocked by the Army. The latter was very impressive, and the reduction in items is still occurring, largely due to increased standardization.

The program continued with the following discussions of methods of shell manufacture:

"Manufacture of Mortar Shells by the Hot-Cup, Cold-Draw Method," by Albert J. Lampert, manager, Rheem Manufacturing Company, Richmond, Calif.

"Manufacture of Mortar Shells by Cold Extrusion," by Parker Bowden, Kennedy-Van Saun Manufacturing Corporation, Danville, Pa.

"Manufacture of Mortar Shells by the Split-Halves Method," by Albert Rypinski, Murray Manufacturing Company, Brooklyn, N. Y.

"Manufacture of Rockets by Cold Extrusion," by Weber deVore, Heintz Manufacturing Company, Philadelphia, Pa.

"Manufacture of Confined-Chamber High-Explosive Shells by Cold Extrusion," by Ben Kaul, Mullins Manufacturing Company, Salem, Ohio.

"Manufacture of Confined-Chamber High-Explosive Shells by Hot-Heat Treat," by W. N. Howley, Jr., Lansdowne Steel & Iron Company, Morton, Pa.

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"Manufacture of Confined-Chamber High-Explosive Shells by Hot-Cup, Cold-Draw Method," by Brig. Gen. Merle H. Davis, U. S. Army, Ret., and L. G. Soper, National Presto Industries, Inc., Eau Claire, Wis.

"Manufacture of Confined-Chamber High-Explosive Shells by the Hot-Cup, Rough-Cut, Cold-Draw Method," by Donald Howard, ACF Industries, Inc., New York, N. Y.

This completed the first day's session. On October 13th the second session was opened with a general discussion monitored by Col. L. W. Worthing, Ordnance Ammunition Command, Joliet, Ill., on the request of the A.O.A. Shell Committee for recommendations as to how to provide for process development of shell manufacturing in the future.

L. E. Hammond, Lehigh, Inc., Easton, Pa., discussed "Steel Castings for Manufacture of High-Explosive Shells."

A number of the Committees of the A.O.A. Advisory Technical and Research Group are closely allied with the Shell Committee in their activities. The chairmen made brief reports on the workings of their Committees as follows:

Cemented Carbide Tooling Committee, Wilbur L. Kennicott, Kennametal, Inc., Latrobe, Pa.

Heating and Heat Treating Furnace Committee, Henry M. Heyn, Surface Combustion Corporation, Toledo, Ohio.

Nonferrous Metallurgy Committee, L. A. Ward, Chase Brass & Copper Company, Waterbury, Conn.

Powder Metallurgy Committee, A. J. Langhammer, Chrysler Corporation, Detroit, Mich.

Surface Preservation Committee, Dr. G. W. Seagren, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Welding Committee, Dr. Albert Muller, Air Reduction Company, Murray Hill, N. J.

Following the Committee reports, Joseph A. Dubin, Picatinny Arsenal, discussed methods of dimensioning shells with respect to ease of manufacture and effecting control of differences among shells in each lot and among different lots.

A number of the unclassified papers will appear later in the Armament Technology section of ORDNANCE. The classified papers, if approved, will be filed with the Armed Services Technical Information Agency.

Powder Metallurgy Committee Discusses Forward Planning

The Powder Metallurgy Committee, Advisory Technical and Research Group, met at the Frankford Arsenal on October 19, 1955, with Chairman A. J. Langhammer in charge. The general subject of the meeting was "Forward Planning—The Services This Committee Can Perform for Ordnance."

Chairman Langhammer outlined the scope of the meeting and welcomed all members and guests. Brig. Gen. Joseph M. Colby, commanding general, Frankford Arsenal, outlined the Army Ordnance interest in the subject of powder metallurgy.

The Naval Ordnance viewpoint in the field of powder metallurgy was presented by Comdr. William Dubyk, Navy Bureau of Ordnance. The Air Force powder metal interests were discussed by Isaac Perlmutter, Wright Air Development Center, Dayton, Ohio.

After this, the following subjects were then covered:

"An Approach to Ordnance Applications" by Roland P. Koehring, General Motors Corporation, Dayton, Ohio.

"Metal Powders—All Types" by David M. Boreina, Metal Powder Association.

"Ferrous Metal Powder—the Powder Producer's Viewpoint" by B. T. du Pont, National Radiator Company, Johnstown, Pa.

"Specifications for High-Density Iron Parts," by R. P. Koehring, General Motors Corporation, Dayton, Ohio.

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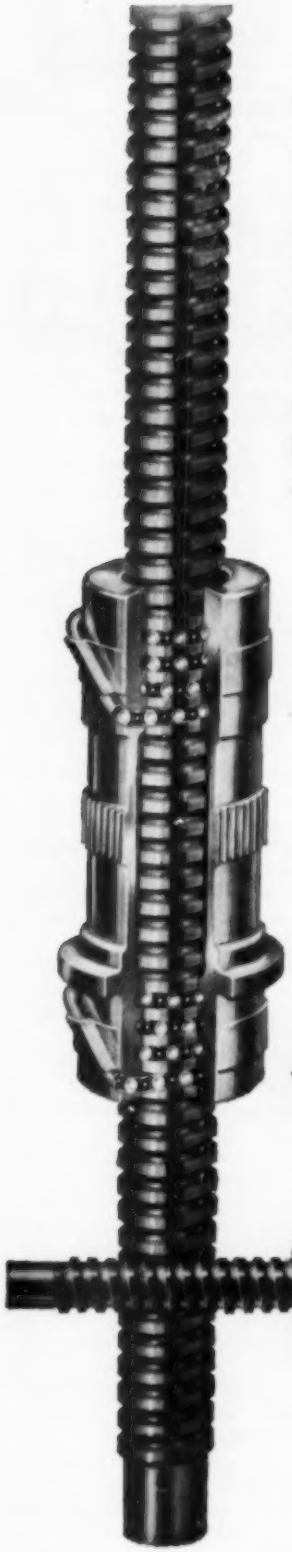

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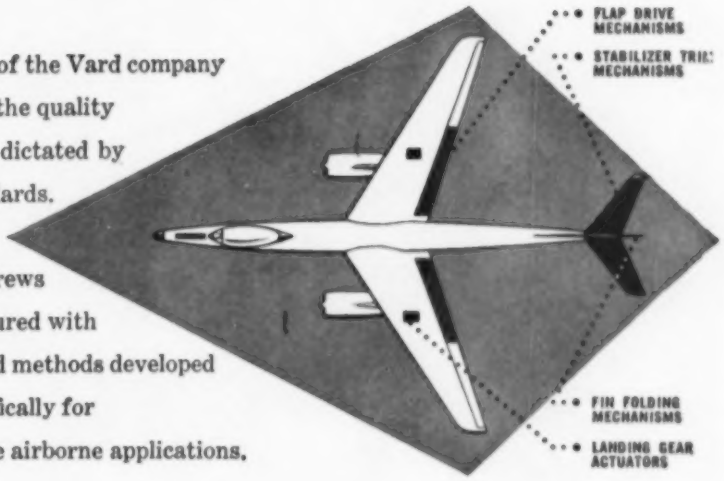

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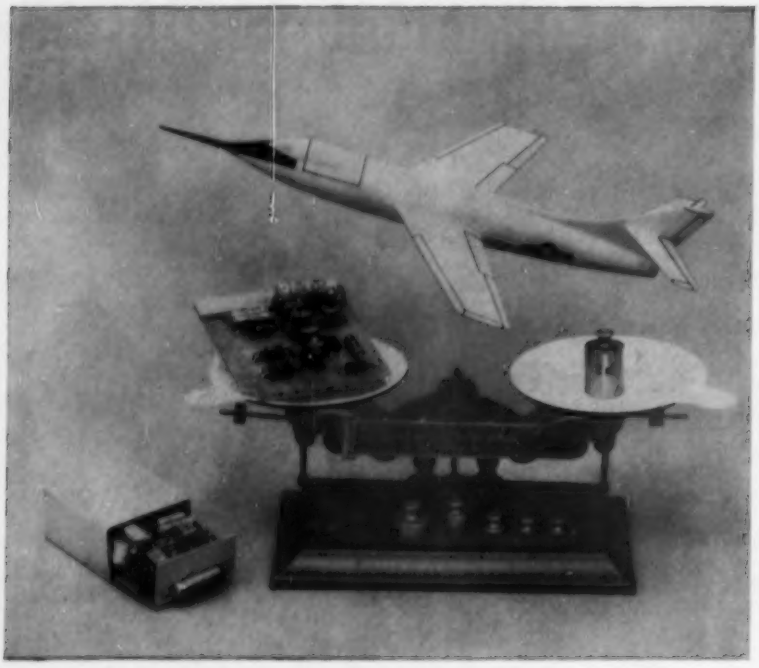

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Association Affairs

Divisions and Committees

"High-Density Parts Under Study at Springfield Armory," by Carl G. Johnson, Presmet Corporation, Worcester, Mass.

"A Press Manufacturer's Viewpoint," by E. V. Crane, E. W. Bliss Company, Canton, Ohio.

"Firing Test Results of Iron Powder Driving Bands," by Warren Blittersdorf, Frankford Arsenal, Philadelphia, Pa.

"Iron Powder Parts for the Chemical and Signal Corps," by Joseph Bonnano, Lionel Corporation, New York, N. Y.

"Forward Thinking of Ordnance in New Developments," by Louis S. Michael, Office, Chief of Ordnance, U. S. Army.

"Powder Metallurgy Applied to Small Arms," by Alfred Hitner, Frankford Arsenal.

"Powder Metallurgy at Watertown Arsenal," by Bennett Bovarnick, Watertown Arsenal, Watertown, Mass.

"Powder Metallurgy at Picatinny Arsenal," by Ed Belkin, Picatinny Arsenal, Dover, N. J.

"Gilding Metal Powder Driving Bands," by K. H. Kuhlen, Chrysler Corporation, Detroit, Mich.

"Powder Metallurgy Horizons," by Dr. G. J. Comstock, Stevens Institute of Technology, Hoboken, N. J.

"Ferromagnetic Progress," by J. A. Roberts, Radio Cores Company, Chicago, Ill.

"Cermets and High-Temperature Materials," by John Redmond, Kennametal Corporation, Latrobe, Pa.

The meeting adjourned at 3:00 p.m. with plans for a spring meeting to be announced later.

MACHINE TOOL COMMITTEE OF ADVISORY TECHNICAL AND RESEARCH GROUP HOLDS ANNUAL MEETING

The Machine Tool Committee, Advisory Technical and Research Group, held its first annual meeting at the Waldorf-Astoria Hotel in New York on October 26, 1955. Walter Tangeman, chairman, was unable to be present, and Ralph S. Howe presided.

The meeting was informal and no agenda was followed. Capt. Walter Tann, U.S.N.R., Ret., Navy Bureau of Ordnance, presented the existing machine-tool problem from the Navy viewpoint. Col. Paul Roberts, Ordnance Corps, chief of PEQUO, Rock Island Arsenal, presented the Army Ordnance problem. Tell Berna, general manager, National Machine Tool Builders' Association, reviewed the industry position, and all present joined in the informal discussion. The

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Divisions and Committees

Committee took under advisement the desirability of having a special ad hoc committee make a study of the critical situation in which the industry will find itself if forecasts are correct.

Brig. Gen. T. K. Vincent, National Headquarters, A.O.A., discussed the Committee responsibilities and suggested the addition of consultants from the services to act as an advisory panel to the Committee.

HEATING AND HEAT TREATING FURNACE COMMITTEE HOLDS GENERAL MEETING IN ATLANTIC CITY, N. J.

The Heating and Heat Treating Furnace Committee met concurrently with the Shell Committee in Atlantic City on October 12 and 13, 1955. Henry M. Heyn, chairman of the Committee, presided. No formal papers were presented and no problems were received from the military services.

The chairman reported that industry in this country was fortunate in having an adequate supply of each of the three media used in heating furnaces—electricity, oil, and gas. The human element is a problem, however, and reduction in the use of manpower will assure a more uniform flow of war matériel at a cheaper cost. Availability and continuity of fuel supply, cost, ease of control, and reduction or elimination of the human element, all must be considered in arriving at the heating medium to use.

EIGHTH MEETING IS HELD BY THE METAL WORKING LUBRICANTS COMMITTEE AT ROCK ISLAND, ILL.

The eighth meeting of the Metal Working Lubricants Committee was held at Rock Island Arsenal, Ill., on November 1, 1955. Chairman Wilbur J. Reitze and Secretary George W. Gleim handled the meeting in their usual efficient manner.

Col. Robert A. Cyr, arsenal commander, gave a fine talk in which the arsenal-industry relationship and interdependence were emphasized.

Chairman Reitze introduced every one present and noted that the Metal Working Lubricants Committee had been formed at Rock Island. The admonition of the commanding officer of the arsenal at that time was not to let the Committee "die on the vine." The very active participation of the Committee in Ordnance-

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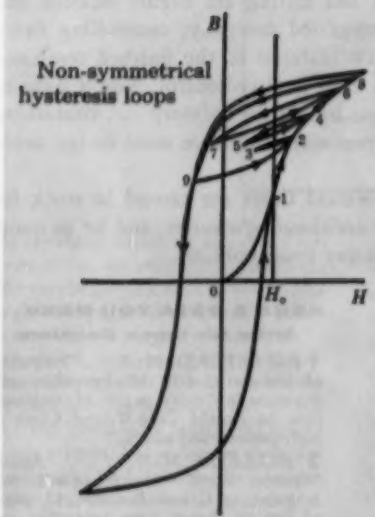

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Divisions and Committees

industry activities speaks well for its obedience to that directive.

Brig. Gen. T. K. Vincent, from national headquarters, spoke of the dedicated military and civilian personnel of the services, the stake the country had reposed in them, and the need for stockpiling this know-how through the medium of our arsenal system.

W. E. Kramer, Gulf Oil Corporation, discussed cutting oil tests conducted by his company, the results of which will be published and distributed.

L. H. Sudholz, Socony-Vacuum Laboratories, reported on the Crown Cork & Seal Method for the Cutting Test Subcommittee.

Springfield Armory had proposed a problem on soluble oil specifications. There was no Springfield Armory representative present to discuss the problem, but Marco Petronio of Frankford Arsenal reported that the informal Intra-Arsenal Lubricants Committee had the subject under consideration.

L. H. Sudholz, Socony-Vacuum Laboratories, reported on American Society for Testing Materials Committee K progress.

After luncheon, at which Brig. Gen. T. A. Weyher, commanding general of the Ordnance Weapons Command, spoke of the mission and organization of his Command, a guided tour of the arsenal was enjoyed by all present. The hospitality of the arsenal staff and the interest shown by all in attendance resulted in another fine meeting for this Committee.

FUZE COMMITTEE OF THE BOMB AND ARTILLERY AMMUNITION DIVISION MEETS AT WHITE OAK, MD.

The Fuze Committee, Bomb and Artillery Ammunition Division, met at the Naval Ordnance Laboratory, White Oak, Md., on December 14, 1955. James E. Burke, vice-president, Stewart-Warner Corporation, is chairman and W. E. Faithorn, also of Stewart-Warner, is secretary of this Committee.

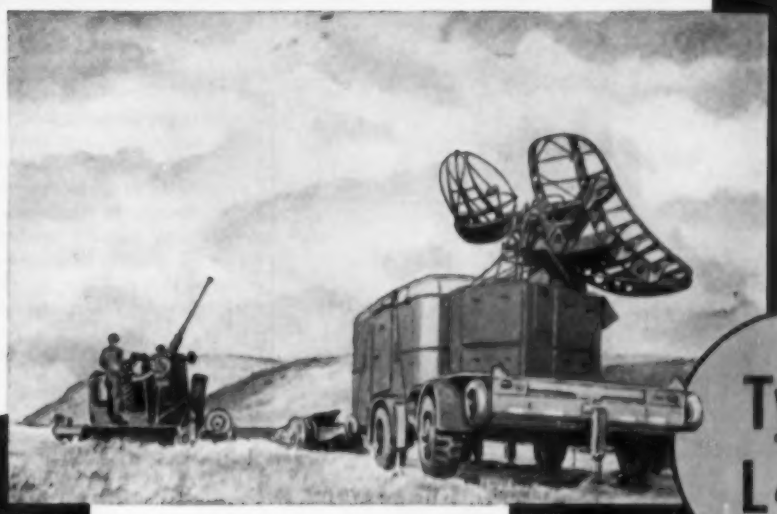
Capt. John T. Hayward, U.S.N., commander of the Naval Ordnance Laboratory, welcomed the Committee and guests, numbering almost 200, to the Laboratory.

Brig. Gen. T. K. Vincent, staff consultant for A.O.A. Technical Divisions and Committees, discussed the progress of the A.O.A. technical bodies during 1955.

Comdr. William B. Rodman, IV, chief, Fuzes, Ammunition, and Explosives Branch, Research and Development Division, Navy Bureau of Ordnance, presented a paper on "Fuze Safety."

N.V. HOLLANDSE SIGNAALAPPARATEN

Hengelo (O) Netherlands



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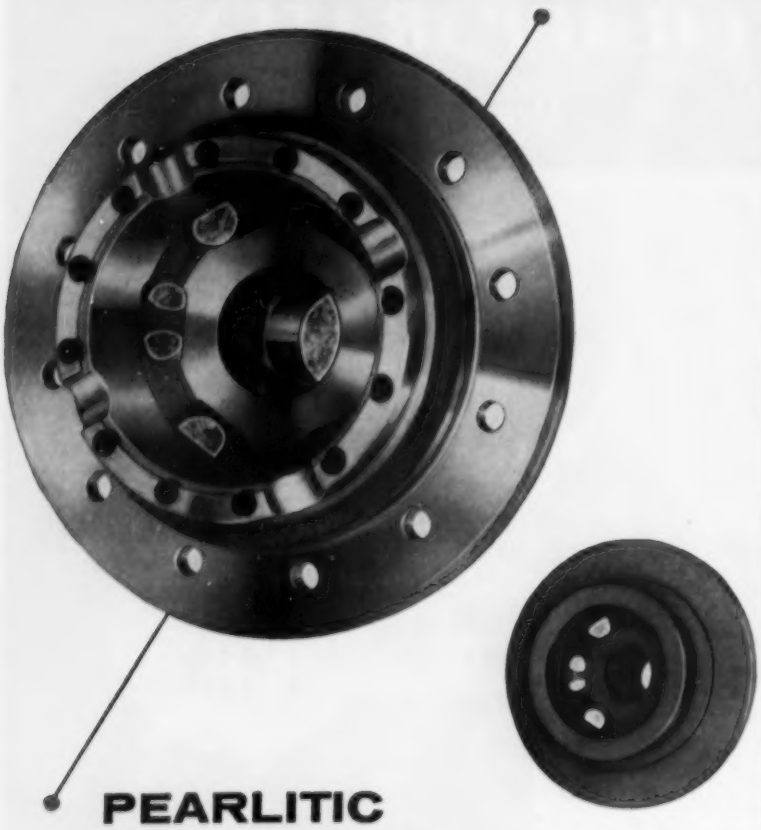

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Association Affairs

Divisions and Committees

Seth W. Booth, chief, Fuze Department, Research and Development, N.O.L., discussed "Automation in Fuze Production."

Col. George A. Pace, Ordnance Corps, acting chief of the Ammunition Branch, Research and Development Division, Office of the Chief of Ordnance, discussed "Aspects of Army Fuze and Ammunition Programs."

Capt. Benjamin L. Lubelsky, U.S.N., assistant director, Management, Research, and Development Division, Navy Bureau of Ordnance, discussed the "Direction of Effort in Research and Development for Fuzes and Related Ammunition Components." He presented the budget cycle in the Bureau of Ordnance which informed many industry members as to the reason for changes in programs. The increase in fuze problems for fuzes used in guided missiles was contrasted with the marked decrease in artillery ammunition fuze requirements. As in other branches of ordnance, reliability is still the ultimate problem.

Comdr. Hugh W. Howard, commander of Destroyer Division 202, gave a paper on "Fleet Operational and Environmental Requirements in Fuze Design and Development." He discussed the good and the bad in connection with the subject in an interesting and understandable manner.

Capt. John H. Brandt, U.S.N., chief of the Ammunition Branch, Material Division, Navy Bureau of Ordnance, spoke on "Procurement Trends in Fuzes." Guided-missile fuzes show increasing activity, and conventional weapons fuzes show a decreasing trend. He presented dollar and percentage figures for groups of fuzes to illustrate these trends.

M. Eugene Jones, assistant director for contract procurement, Contract Division, Navy Bureau of Ordnance, discussed "Current Aspects of Contractual Procedures, Problems, and Relationships between the Navy and Industry." He handled this difficult and little-appreciated subject in an interesting and enlightening manner.

S. S. Podnos, director, Ordnance and Transport Equipment, Office of the Assistant Secretary of Defense (Applications Engineering), read a paper on "Applications Engineering—Its Rôle in the Department of Defense." This relatively new staff organization has a definite place in the weapon-development complex, and the speaker explained its operation and procedures.

Rear Adm. J. H. Ward, Assistant Chief of the Navy Bureau of Ordnance for Planning and Programs, discussed "Aspects of Naval Ordnance and Defense

A smile is his umbrella

"If anyone believes our smiles involve abandonment of the teachings of Marx, Engels and Lenin, he deceives himself poorly. Those who wait for that must wait until a shrimp learns to whistle."

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Association Affairs

Divisions and Committees

Department Programs—The Transition Period in Naval Ordnance." He stressed the new look in testing procedures and the requirement for "built-in" reliability. The value of the advice given by the A.O.A. Technical Committees was noted and its continuance was requested.

EXECUTIVE BOARD, COMBAT AND TACTICAL VEHICLE DIVISION, MEETS TO COMPLETE ORGANIZATION

The Executive Board of the Combat and Tactical Vehicle Division met with the chairman, Robert T. Keller, Chrysler Corporation, and the secretary, Ralph Cantlay, Chrysler Corporation, at the Detroit Arsenal, Centerline, Mich., on November 15, 1955, to complete the organizational structure of the Division.

Col. Roger Hemion, Ordnance Corps, commanding officer of the Detroit Arsenal, welcomed the Division. He outlined some of the problems which concerned the arsenal in connection with combat vehicles.

Brig. Gen. T. K. Vincent, from national headquarters, A.O.A., discussed the broad policies covering the technical activities of the Association.

Chairman Keller stated that all fire-control and related component matters would be handled by the Combat Vehicle Fire Control Committee of the Fire Control Instrument Division. He gave Committee chairmen full authority to select members of their Committees, subject to his review.

The chairman expects to hold an annual meeting of the entire Division and authorized Committees to meet as often as necessary, keeping him supplied with minutes of such meetings.

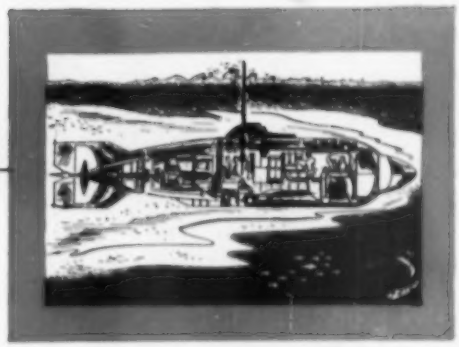
The name of the Division has been changed to "Combat and Tactical Vehicle Division" so as to include all related vehicles for which the Division is responsible.

The Tank Committee was changed to "Track Vehicle Committee" and a "Wheeled Vehicle Committee" is being established. The Engine Committtee was changed to the "Engines and Power Train Committee."

After lunch at the arsenal the group enjoyed a conducted tour of the research and development facilities, followed by an excellent presentation of the entire research and development picture by Col. George T. Petersen, Ordnance Corps, chief of the Research and Development Division, Detroit Arsenal.

PRIVATE EYE FOR THE U. S. NAVY

NUMBER 10 OF A SERIES



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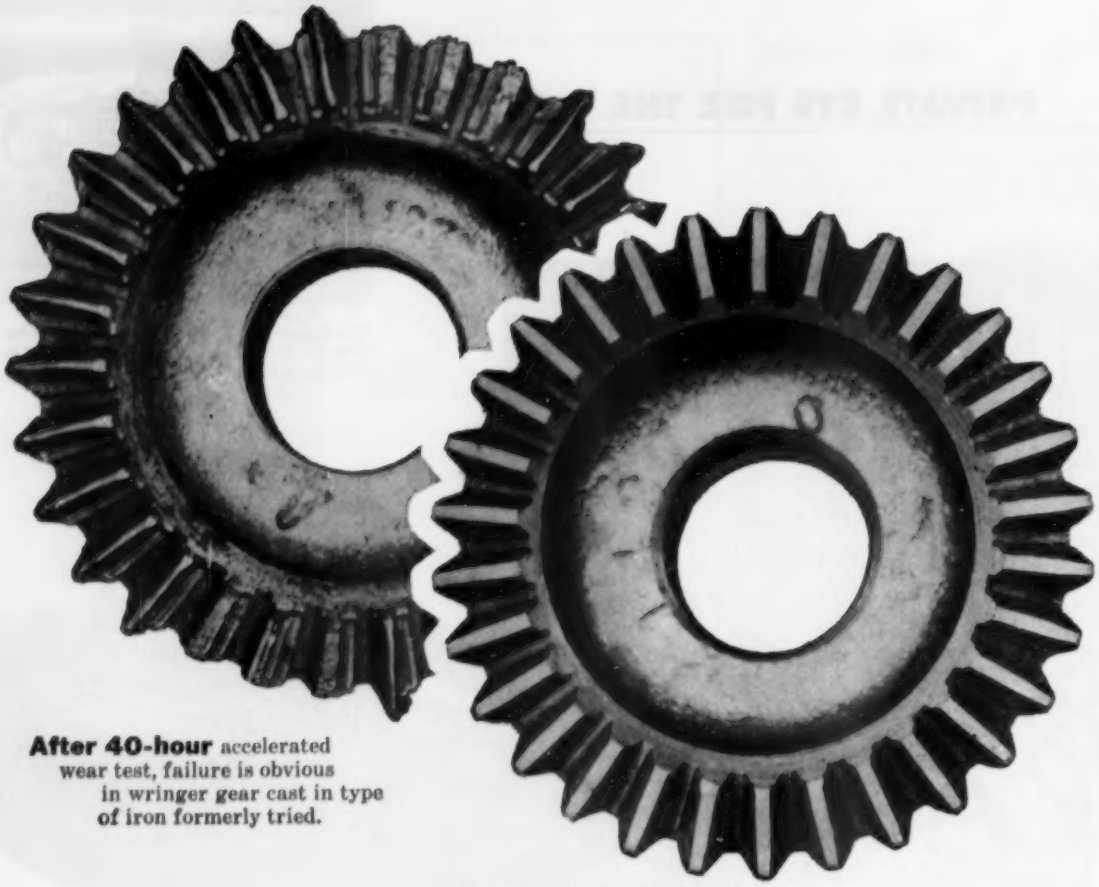

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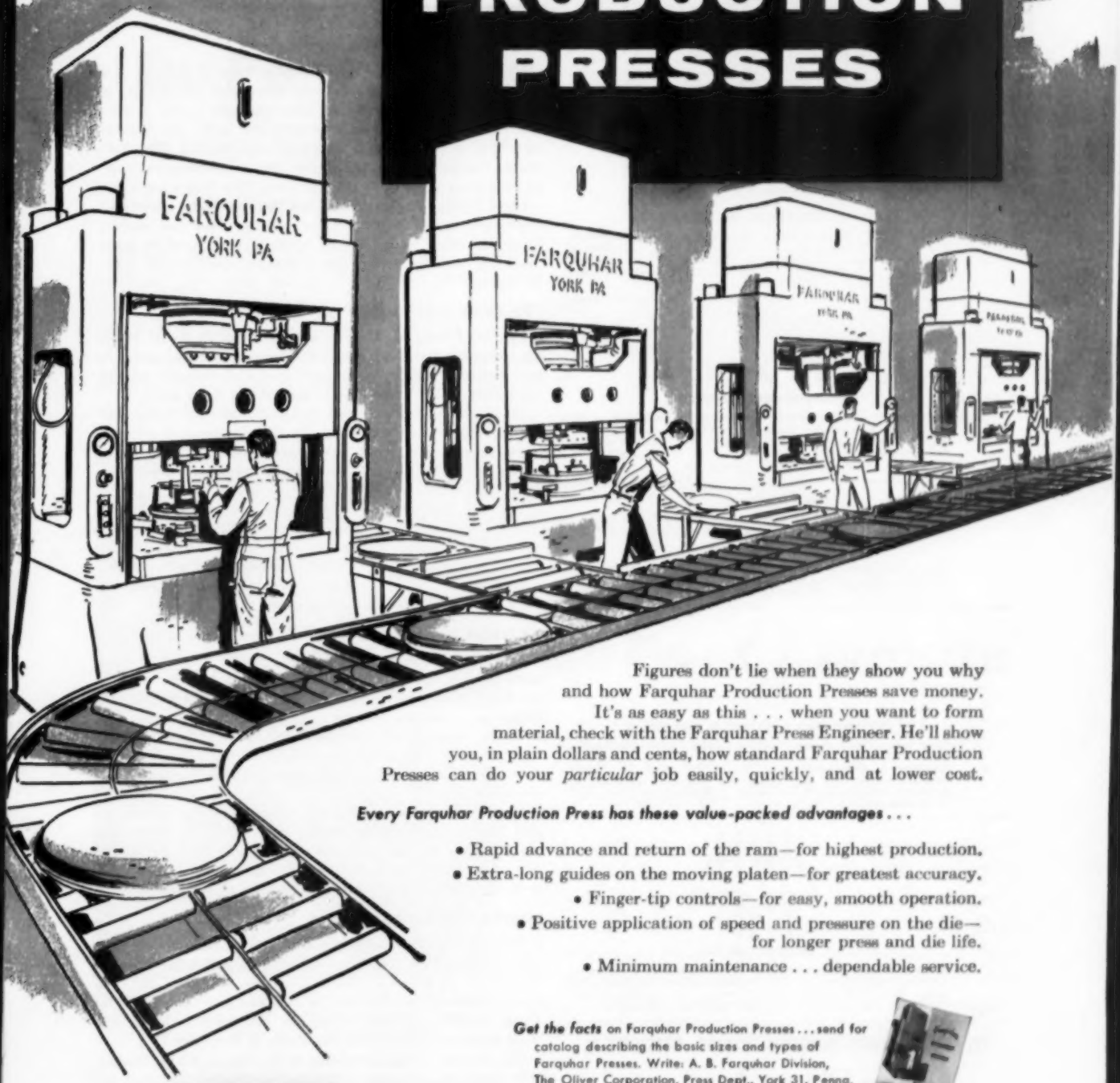

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CONTINUOUS COATING

This year Aetna will have completed the building of 25 continuous galvanizing lines, in addition to several terne and electrolytic tinning lines. Aetna has worked closely with industry in this development and is considered the pioneer in continuous coating equipment.

ROLLS

Aetna specializes in manufacture of small and medium-sized iron-base rolls. Aetna is pioneering in the use of Nodular Iron for rolls and castings under trade name of Magaloy.

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Over the years, new ideas and engineering accomplishments have strengthened Aetna's position as the only builder in America of Continuous Butt Weld Pipe Mills. In recent months, Aetna Pipe Mill equipment has been installed in America, in Canada, in Germany, in England, in Japan and in Argentina.

COLD DRAWING

The world over, Aetna-Standard is recognized as the leading authority and builder of cold draw equipment for tubes and bars. This year marked introduction of several innovations by Aetna, such as the air gripper carriage and hook.

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NEW DEVELOPMENTS

NEW ANTITANK WEAPON

The long-felt need for a self-propelled airborne antitank gun to oppose enemy armor and perform other tank assault rôles in airborne operations may at last have been met by the Army's new T101 track-laying 90-mm. weapon now under test. Weighing 15,800 pounds, the new vehicle is powered by a 205-horsepower, 6-cylinder, air-cooled engine with cross-drive transmission and has a speed of 30 miles an hour. (See front cover.)

The T101 has an unarmored tanklike body made entirely of lightweight metals so that it can traverse snow and muddy, marshy, or sandy terrain and be dropped from aircraft by parachute. The powerful 90-mm. gun is mounted above the hull without turret.

"FLYING SAUCERS"

The Air Force, reporting on the results of an 8-year study, has concluded that there is no such thing as a flying saucer. It said, however, that it might soon have a disk-shaped aircraft "somewhat similar to the popular concept of a flying saucer."

Air Force Secretary Donald A. Quarles also announced that the Air Force soon would fly the first jet-powered vertical-rising aircraft at Edwards Air Force Base, Calif. The delta-winged craft was built by the Ryan Aëronautical Corporation, San Diego, Calif.

"We are now entering a period of aviation technology in which aircraft of unusal configuration and flight characteristics will begin to appear," Mr. Quarles said. "Vertical-rising aircraft capable of transition to supersonic horizontal flight will be a new phenomenon in our skies, and under certain conditions could give the illusion of the so-called flying saucer."

GUIDED MISSILE SUBS

Growing emphasis on development of the submarine as a guided-missile ship can be expected, according to Secretary of the Navy Charles S. Thomas who said that guided missiles have opened up a vast new field for underseas craft. Submarines, able to operate unsupported and undetected in enemy waters, could surface at any point to launch missiles of deadly accuracy and destruction. They could then disappear and launch other attacks elsewhere.

Experimentation was begun with the conversion of the submarine TUNNY into a guided-missile vessel in 1953. A sister ship, the BARBERO, is now undergoing conversion. In addition, the Navy has included in its 1956 shipbuilding program a submarine to be designed from the keel up for guided-missile attack.

UNMANNED SATELLITE

The contract for a major part of the globe-circling earth satellite, announced by President Eisenhower last July, has been awarded to the Glenn L. Martin Company, Baltimore, Md. The small, unmanned satellite will be launched into outer space by U. S. scientists sometime during the International Geophysical Year beginning in July 1957 and ending in December 1958.

The Martin Company, builders of the Navy's Viking Rocket, will make the multistage launching vehicle that will hurl the satellite into outer space. General Electric Company will supply the rocket motor to be used in the first stage of the launching vehicle. As "Project Vanguard" develops, other contracts for portions of the launching vehicle will be awarded to different industrial sources.

The size and shape of the satellite have not yet been deter-

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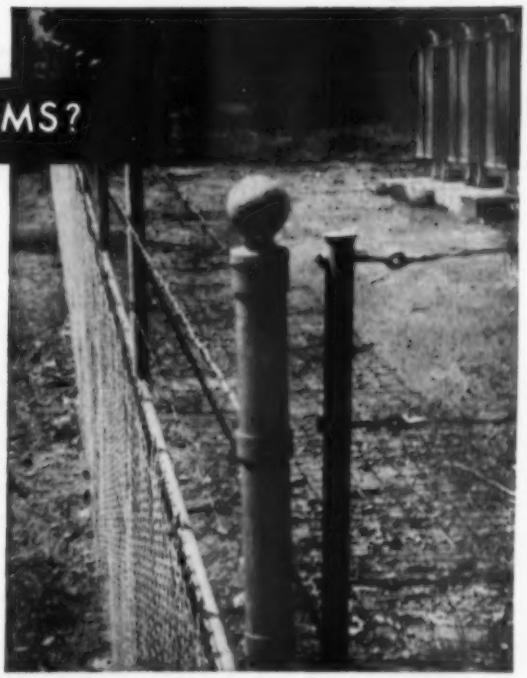

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On all chemicals always follow directions for application. Where warning or caution statements on use of product are given, read them carefully.

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New Developments

mined, but it will be large enough to contain a number of instruments and to be tracked from the ground by optical and radio devices.

GUN COVER

A unique type of snow cover, designed to protect antiaircraft weapons from the ice and snow of Alaska's winters, was recently demonstrated at Battery A, 867th Antiaircraft Battalion, Fort Richardson, Alaska. The first component of the snow cover is a frame made of ¾-inch pipe which can be quickly assembled around the gun. A pyramid tent to which has been added an 18-inch canvas skirt is then placed around the frame. The tent is held upright by a center pole resting on the metal plate of the radar console. A heater circulates warm air inside the enclosure.

Snow cover for antiaircraft gun (Army photo).

The main purpose of the cover is to provide a shelter for antiaircraft weapons against the cold, and to allow maintenance personnel to perform operational checks on the guns without gloves.

ARMY OF FUTURE

A picture of the Army of the future and some of the "radical changes" in weapons it would use were discussed recently by the Army's Chief of Research and Development, Lieut. Gen. James M. Gavin, at the first annual meeting of the Association of the U. S. Army, Fort Benning, Ga. General Gavin said that during the 1960-1970 period the Army would have these advanced military developments:

1. Nuclear shells for cannon smaller and more mobile than the present 280-mm. atomic gun.
2. Improved Redstone artillery missiles with ranges up to 150 miles or more.
3. An improved version of the Wac Corporal, called the Sergeant.
4. Smaller rockets with greater power than the Honest John.

He also envisioned a missile that would be capable of intercepting and destroying an intercontinental ballistic missile, the ocean-spanning weapon that is still on the drawing boards.

"The traditional artillery gun may well be on the way to obsolescence," General Gavin declared, "for the new missiles have almost unbelievable possibilities both for antiaircraft and antitank purposes and for all kinds of other enemy targets."

Most battle supplies, he said, should be delivered by assault cargo and convertiplane aircraft. The tactical transport of units into and within the battle area must be accomplished by aircraft and fast naval vessels.

Tactical units would possibly be smaller regimental combat teams or integrated battle groups of all arms. They would be semi-independent, self-contained, and capable of operating over extended distances with little direction by higher headquarters.

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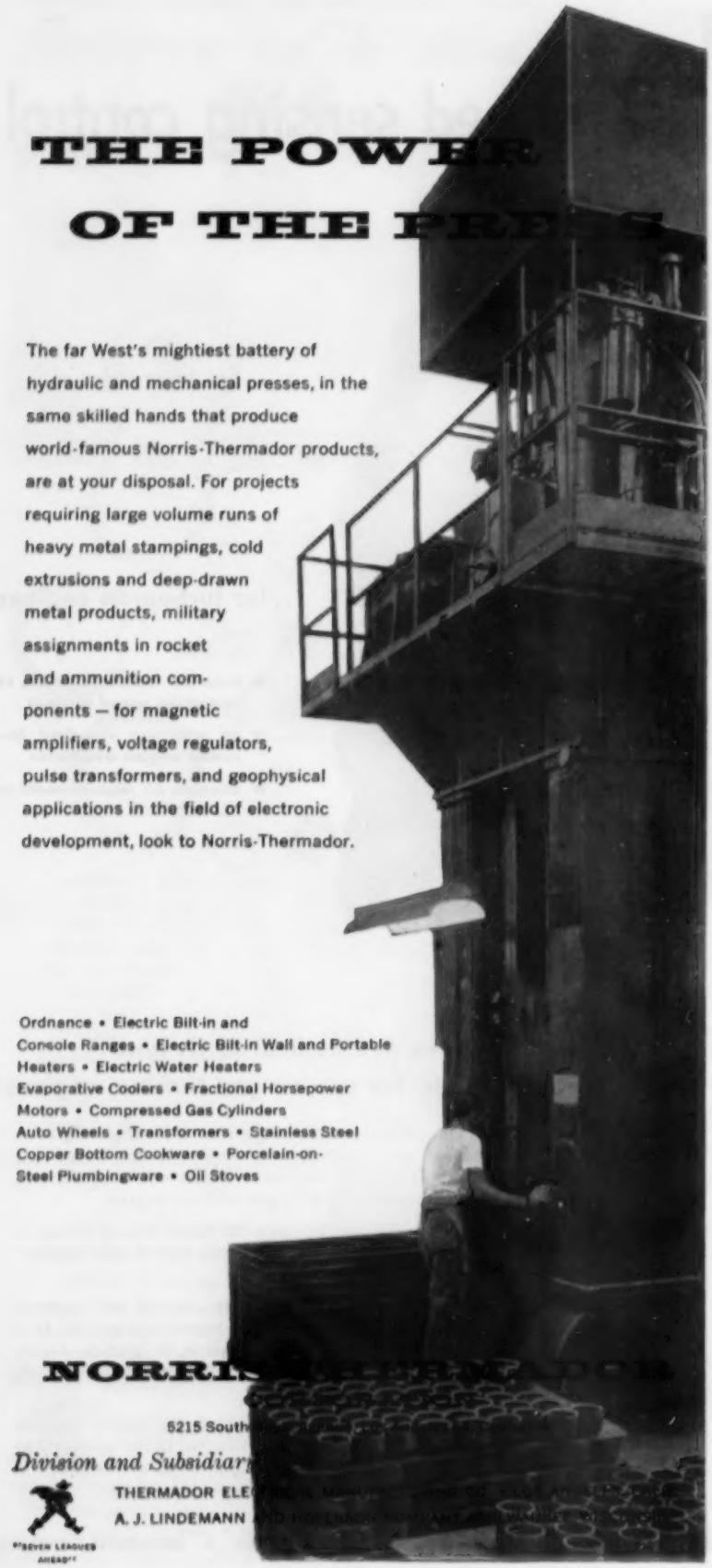
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"SEVEN LEAGUES AHEAD"

New Developments

ATOMIC AIRCRAFT

The Air Force will have a nuclear-powered airplane flying within ten years according to Gen. Thomas D. White, Air Force Vice Chief of Staff. General White disclosed that the Air Force is working in conjunction with the Atomic Energy Commission on the project. "We have passed the point of uncertainty," he declared. "We know we can build a nuclear-powered airplane."

The atomic plane, in addition to its high speed, will have "unlimited" range and endurance.

General White said the atomic airplane could be effective retaliation against enemy guided missiles since a fleet of atomic aircraft could theoretically remain airborne at all times, ready to launch a counter-attack. He indicated that, with the use of nuclear-powered engines, the Air Force, for the first time, might build water-based bombers for strategic missions.

HYDROFOIL CRAFT

The Navy is experimenting with some fast-moving hydrofoil craft resembling small airplanes. They make seventy-five miles an hour through the water and are powered by two aircraft engines. They ride on three foil-equipped struts, one under each wing and the tail. Water flowing across the foils provides the lift to skim the surface. They make twice the speed of conventional craft with the same power.

TRANSISTOR CONTROLS

The Navy Bureau of Ordnance has announced the development of a new ultrasonic control system for torpedoes, in which, for the first time, transistors are used to replace completely the usual assortment of electronic tubes. Developed by scientists at the Westinghouse Research Laboratories, the fully transistorized system brings to torpedo control all the proven advantages of transistors including extreme ruggedness, small size, high reliability of operation, and low electrical power requirements.

Purpose of the control is automatically to direct the path of a torpedo to an enemy target. It does this by utilizing sound waves in the water. Once the torpedo is launched, the control "takes over" and causes the torpedo to seek out and follow its target without human assistance.

AUTOMATIC "BRAIN"

The Air Force and Hughes Aircraft Company have announced the development of an electronics system which flies interceptor aircraft automatically "from take-off to touchdown" and which accurately could seek out enemy bombers before they struck American cities. The pilot's only function in the new, almost completely

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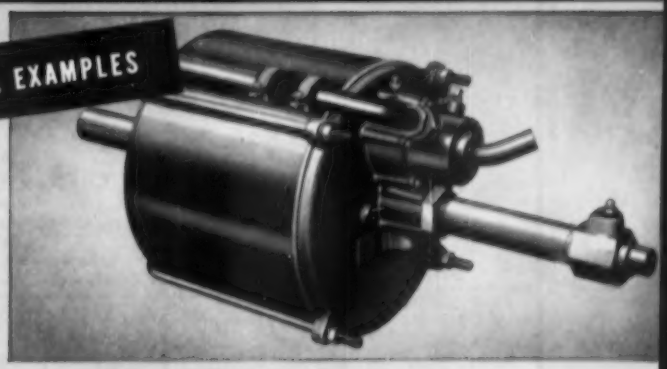
TYPICAL EXAMPLES



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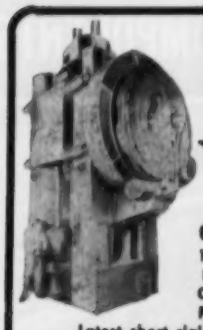

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New Developments

automatic system will be to take off and then land the airplane.

The electronic control system has reportedly shifted combat advantage from the offense to the defense, and any aggressor will have to gamble on losing a high proportion of bombers. The system will automatically locate and approach an enemy bomber from the most effective angle, will automatically fire the interceptor's armament at exactly the correct moment for maximum results and then automatically return the interceptor to its base for the pilot to land it.

"SKY CAVALRY"

A revolutionary new company-size unit employing helicopters, fixed-wing aircraft, jeeps, and tanks to test new battlefield concepts has been formed by the Army. Dubbed "SkyCav," the unit was organized at Fort Bragg, N. C., last August.

Using airborne television, photographic, radio, and radar equipment, it is designed quickly to provide commanders with information about the enemy. Similar equipment is employed in jeeps and tanks.

FLYING SUBMARINE

An idea for a flying submarine equipped with water skis, the patent on which was kept secret for several years by the Department of Defense, has been announced by All American Engineering Company, Wilmington, Del. Still only in the primary stage of development, the new craft does not differ markedly in appearance from a standard swept-wing jet fighter, but it utilizes two power plants—a jet engine with air intakes on the upper part of the fuselage for air operation and a marine engine driving a small propeller at the rear of the craft for underwater propulsion. In flight, the marine propeller is retracted within the fuselage.

In the 2-medium operation, the pilot of the flying submarine would start the marine engine just before landing. Landing on its hydrolift skis, the craft would aquaplane until it slowed down and came to rest on its hull. The jet engine would then be stopped, the air intakes and exhaust sealed, and the cabin pressurization turned on. Then the craft would take in water in ballast tanks and submerge, driven by its marine propeller and maneuvered by its airplane control surfaces. A retractable periscope would provide contact with the surface.

COLD FOR RESEARCH

A magnetic refrigerator has been developed by Arthur D. Little, Inc., that it is claimed will maintain temperatures 500 degrees colder than the household refrigerator and within a fraction of a degree of the coldest temperature scientists believe possible.

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New Developments

The refrigerator is designed as a research tool and is controlled entirely by external magnetic fields. It has no moving parts or flowing liquids in the cooling system. It uses, instead, a plastic capsule three inches long containing a special chemical salt as the refrigerant.

The first machine has been purchased by the Naval Research Laboratory in Washington. In research, the refrigerator will help determine the specific heat of various metals and elements and make possible study of magnetic properties of substances.

POLAR AIDS

New developments that may help conquer the frozen polar wastes recently have been disclosed by the Army. They include an electronic crevasse detector and electric trail marker which for the first time make it possible to travel over ice and snow during day or night. Another discovery is that tunneling under polar ice and snow is surprisingly practical and may be a cheap and easy means of providing shelter.

The crevasse detector is said to have been tested already on Weasels and other tracked vehicles. It sets up a field of vibration ahead of the vehicle, and when the field of vibration is interrupted it indicates that a crevasse lies ahead.

The trail markers consist of two uninsulated wires laid along each side of the route with batteries placed at intervals transmitting impulses through the wires. An instrument in the vehicle traveling along the trail picks up the electrical impulses and enables the driver to stay on the path despite darkness or stormy weather.

MINIATURE RADIO

Developed by the Air Research and Development Command, an improved, miniature emergency radio which permits a stranded airman to direct his own rescue weighs only fifteen ounces and has a volume of twenty cubic inches. Approximately half as large and heavy as rescue radios now in use, the combination transmitter and receiver will be included in the survival kits carried by Air Force personnel when flying over water or wilderness areas. Designated the URC-11, the new radio contains 6 subminiature tubes and under normal conditions will transmit from 50 to 100 miles.

GUIDED MISSILE SHIP

The world's first guided missile cruiser —the newly converted U.S.S. Boston (CAG-1)—has joined the Navy's modern fleet to become the first combat ship capable of firing supersonic antiaircraft guided missiles. This ship with its associated radars and guidance systems for Terrier and other antiaircraft missiles represents a complete new naval weapons system specifically designed to further the Navy's mission of control of the seas.

DESIGN-PROTOTYPE-PRODUCTION. That's NORTHROP ANAHEIM'S part in this picture. Shown in cross-section, above right, is the new NORTHROP SKY SCREEN. Here's how it works: Approaching aircraft (1), picked up by radar (2), appears as a "pip" on surveillance scope (3), mounted (4) in top of Sky Screen. "Pip" is reflected off one way mirror (5) so it appears to lie on plotting lens (6). Marker chips placed on plotting lens to coincide with "pips" are reflected through a unique, variable magnification and focus lens system onto the translucent surveillance screen (7). Normally several Sky Screens project overlapping radar presentations onto the surveillance screen. Command group (8) thus views an enlarged composite radar plot with each aircraft identified by the number and color of the chip used. The command group establishes identification of the aircraft and directs interception (9) if aircraft is hostile. The Northrop Sky Screen thus gives up-to-the-second transmission of radar information to a command group of any required size with neither interpretation nor translation error.

In perfecting and manufacturing the Northrop Sky Screen, Northrop Anaheim worked from a basic concept by Control System Laboratory, University of Illinois, and from prototypes developed by the Intelligence Branch of Rome Air Development Center. Northrop Anaheim is now manufacturing this vital defense link in quantity for the U. S. Air Force. This unit is, in its present form, readily adaptable to air traffic control, harbor control, civil defense, shipboard—for all applications using radar traffic control.

Northrop Anaheim designs, develops and produces products that demand exacting tolerances

A part of Northrop Anaheim's expanding capacity is now available to design and manufacture precision equipment for you.

A Division of Northrop Aircraft, Inc., Northrop Anaheim is a completely self-contained facility with 350,000 sq. ft. of plant area located in Anaheim, California. In addition to its own fully integrated engineering, tooling, testing and manufacturing facilities, Northrop Anaheim enjoys access to the company's home-plant 3000-man Engineering facilities.

In addition to the Sky Screen, Northrop Anaheim has produced a wide variety of micro-precision optical and mechanical equipment and armament.

Northrop Anaheim customers have included:

The Fisher Body Division	Ford Motor Company, Tank Division
Ingersoll Kalamazoo Div. Borg Warner Corp.	Raytheon Manufacturing Company
U.S. Air Force	U.S. Army Ordnance Corps
U.S. Marine Corps	U.S. Navy (BuOrd, BuShips, BuAer)

Northrop Anaheim is a West Coast design and manufacturing organization that can augment your own engineering and production capacity. Northrop Anaheim can take your basic ideas through research and/or development into volume production at low unit cost.

For further information regarding the Northrop Sky Screen or for consultation on your design, development or production problems, please contact Richard R. Nolan, Division Manager.

NORTHROP ANAHEIM

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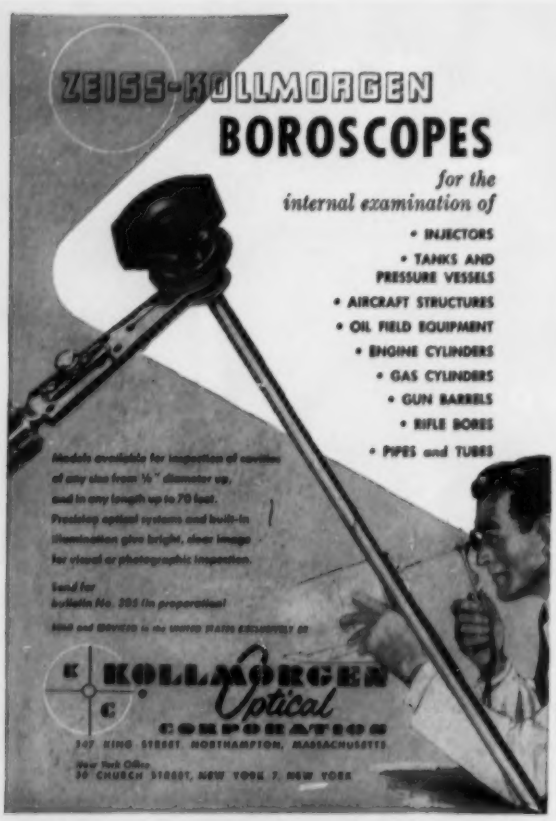
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MATERIALS PROGRESS

George S. Brady

Zirconium.—Attention of a number of metallurgical laboratories is now sharply centered on zirconium, largely sparked by a recent announcement of the Atomic Energy Commission that its annual requirements for this hitherto rare metal would soon expand to three times the present usage.

Zirconium has been most widely known for its use as an oxide in refractories, and it is also used to give special properties to steels and bronzes, but its present large prospective use is for corrosion-resistant construction alloys.

Zirconium is not a rare metal in the strict sense of its occurrence in nature. In fact, according to the U. S. Geological Survey, it has a higher average percentage occurrence in igneous rocks than nickel or copper. But the separation of the metal from its ores is difficult and costly.

Furthermore, it occurs intimately linked with hafnium, and this latter metal is a neutron absorber and must be separated from it for atomic energy use. The two metals are so near alike in physical properties that the separation is difficult. Progress is being made, however, as is evidenced by a recent drop in price of hafnium-free zirconium ingot from $33 to $23 a pound.

After much experimentation, *Westinghouse Electric Corporation* turned to the high-cost and relatively scarce zirconium as a metal that would withstand the intense corrosive action of high-pressure, high-temperature water and still meet nuclear requirements.

The alloy developed to meet these conditions, called Zircoloy 2, contains 1.5 per cent tin, 0.10 chromium, 0.05 nickel, and 0.12 iron. Even slight amounts of nitrogen, oxygen, and other impurities in zirconium greatly affect the corrosion resistance and physical properties of the alloy, so that the metal used must be pure. The new nuclear power station of the Duquesne Lighting Company at Shippingport, Pa., will have Zircoloy-clad elements in the reactor.

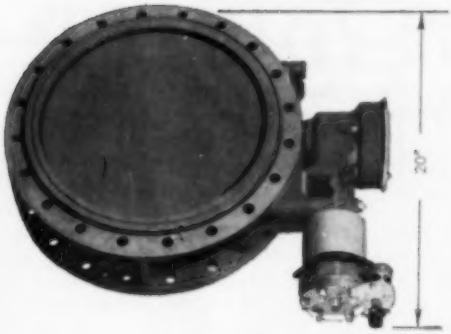
Helicopter Lamps.—A new identifying lamp for helicopters developed by the *Westinghouse Electric Corporation*, East Pittsburgh, Pa., and the *Kaman Aircraft Corporation*, Bloomfield, N. J., to withstand centrifugal forces 1,000 times its weight, has two closely spaced tightly coiled filament wires rigidly supported.

The 12-volt lamp gives a 35-candlepower glow with the effective light increased nine times by reflectors. The lamps are installed in the blade tips. Silver slip rings and silver brushes at the blade hub transfer electrical power from the fuselage to the blades.

New Bulb.—In a new 30-200-300-watt 3-way bulb for table and desk lamps developed by the *General Electric Company*, a coating of white silica is put on the inside of the bulb to give a better diffusion of light with reduced reflected glare and softer shadows.

Farm Materials.—Regardless of his political leanings, any fair-minded observer who considers the effects of technical progress must sympathize with the Department of Agriculture in its efforts to balance the prices and supplies of materials produced on the farms. In spite of costly acreage controls aimed at cutting cotton acreage 14 per cent, the 1955 cotton crop is now estimated at 13,928,000 bales, or 2 per cent above that of last year.

Add to this the fact that the production of synthetic textile



It's mighty cold

where these valves are going!

LIKE ALL CLARY CONTROLS for guided missiles, the valves you see on this page are built to withstand extreme environmental conditions. They are required to operate in temperatures ranging from 160 degrees above zero to *320 degrees below!*

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COMPLETE, FOLLOW-THROUGH SERVICE on automatic controls is a Clary specialty and includes:

- **DESIGNING AND TESTING** to established specifications and envelope drawings.
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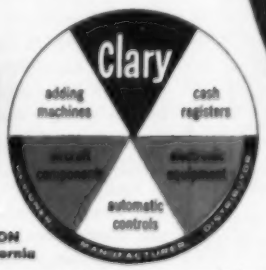
Above left, gate-type propellant valve; right, check valve
Below, "CORPORAL" propellant valve.



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Materials Progress

fibers is increasing rapidly, and the condition becomes more complicated. Manufacture of acrylic fibers alone (Orlon, Acrilan, and Dynel) has jumped to 60,000,000 pounds this year and is expected to surpass 80,000,000 pounds in 1956. Only about 10 per cent of these fibers is going into industrial uses, the remainder being used in clothing and house-furnishing fabrics formerly made from cotton and wool.

The efficiency of the large cotton producer, with modern equipment and better growing methods, has increased enormously, making parity-formula price comparisons with past years of no real value. The heartbeats of the politically minded go out to the "little fellow," and it is this attitude that is largely reflected by the public. But a technical analysis indicates that what is true of the metal industries is also true of the agricultural-materials industries; namely, that formulas giving comparisons with past times are of little value and that only the producers who can afford to use the latest modern equipment and methods can produce at a price that will meet the competition from new materials.

Flame-Resistant Cotton.—The *Southern Regional Research Laboratory*, Department of Agriculture, has developed a process for giving high flame resistance to cotton fabric without altering the normal fabric properties. The process uses unique chemicals. One part of a chemical called Tetrakis, which is hydroxy methyl phosphoronium chloride, is mixed with two parts of bromoformallyl phosphate, and the mixture is used as a one-bath treatment. The cloth is impregnated, dried, and cured by heat.

The first chemical forms an insoluble polymer within the fiber, and the second coats each fiber with another insoluble polymer. The weight of the cotton fabric is increased eighteen per cent, but it is otherwise unchanged in physical characteristics. The treated cloth will withstand the most stringent tests for flame resistance. The coatings will not wash off in laundering or dry cleaning.

Aluminum Bus Bars.—Aluminum has been replacing copper for bus bars, having the advantage that it gives sixty-one per cent of the electrical conductivity of copper with only one-third the weight. But a disadvantage is that a thin film of oxide forms on the surface, and this invisible film at the joints is highly resistant to electric current. Now, the *Westinghouse Electric Corporation* has developed a process for silver plating the aluminum bars without any included oxide, thus eliminating the resistance.

The oxide is dissolved off the aluminum with a caustic cleaner, and the bars are immediately immersed in a solution of sodium zincate which produces a tightly adherent thin film of zinc on the aluminum. This gives a good base for the silver strike. The strike for 15 seconds at a current density of 20 amperes is necessary to prevent poor adhesion and blistering of the silver plate which is applied in 12 minutes at 10 amperes to produce a minimum silver thickness of 0.0002-inch. The silver-plated aluminum bus bars will satisfy the same temperature rise and joint-resistance requirements as silver-plated copper bus-bar joints.

Insulating Medium.—While one company was working to get rid of the oxide coating on aluminum as undesirable for bus bars, *Reynolds Metals Company* engineers were seeking to utilize the oxide coating as an effective insulating medium for conductors. Reynolds has developed a method for building up the oxide coating from the natural 0.0002-inch thickness by a special anodizing to give a heavy electrically resistant coat.

Aluminum sheet or foil anodized in this way is used instead of insulated wire for electromagnetic coils, producing coils lighter in weight and more compact than coils wound with copper wire. The anodized aluminum coils have a higher heat-dissipation factor than ordinary insulated wire coils. Moreover, the anodized oxide insulation will not burn out even at higher heats since the melting point of the oxide is higher than that of the aluminum

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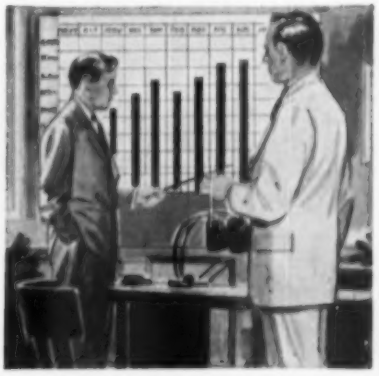

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itself. The coil weight is only one-half that of a comparable copper wire coil, and the winding is less costly.

Meat Processing Machine.—Not all the materials needed by our armed forces come out of mines or are capable of being stockpiled. Tremendous quantities of bacon, ham, and other smoked meats are consumed by the military forces, and only rapid labor-saving methods of production can ensure an adequate supply. A new continuous smoking and cooking machine developed by *Kingan, Inc.*, Indianapolis, Ind., is seventy feet long. One machine cooks and smokes 3,000 pounds of ham an hour, employing a single operator.

Ionizing wires and plates in the smoke section carry 25,000 to 40,000 volts. As the smoke passes the ionizers it is driven electrostatically through the meat which has been cooked in passing through a 50-foot section of infrared oven. The final section of the machine consists of 10 feet of infrared oven at 200 degrees Fahrenheit to set the smoke in the meat.

Magnesium Parts.—About 160 magnesium sand castings and magnesium forgings are used in the flight- and engine-control systems of the Piasecki H-21 helicopter employed by both the Army and the Air Force. Thirteen more magnesium sand castings are used in the transmission and drive systems. Magnesium sheet, 0.040- to 0.071-inch thick is employed in the dorsal fairing, cockpit console, and other parts. A high strength-weight factor and stiffness recommended the use of magnesium.

Ever since the Korean war emergency, when the use of 18-8 stainless steel was strictly limited, efforts have been made to develop an alloy that would require less nickel and still have approximately the same properties as the standard 18-8 stainless; namely, high strength, corrosion resistance, workability, weldability, and white color.

New Stainless Steel.—The straight chromium steels which were largely substituted at that time were difficult to work, and the duller color was not satisfactory for food equipment. The high-manganese stainless steels which were put into production toward the end of the emergency did not correspond to the 18-8 steels in chemical resistance, and they were more difficult to work, even with some nickel in the alloy.

Now, *Allegheny Ludlum Steel Corporation*, Pittsburgh, Pa., is producing a new alloy in the form of sheet and strip which has about the same physical properties and corrosion resistance as 18-8 steel and can be worked with the same tools. It also has a good white color desirable for restaurant, bakery, and food-handling equipment. The new stainless steel, which has been designated as AISI Type 201, contains 17 per cent chromium, 4 nickel, and 6 manganese.

Plastic Blower.—Scarce strategic alloying metals have been eliminated in a new series of blowers designed by the *Heil Process Equipment Corporation*, Cleveland, Ohio, for handling corrosive fumes. The entire housing and the impeller are constructed of rigid polyvinyl chloride plastic. The three sizes of blowers are from 500 to 3,000 cubic feet a minute. The plastic will withstand operating temperatures to 150 degrees Fahrenheit, but for temperatures to 200 degrees a glass-fiber-reënforced plastic may be had.

Plywood.—A laminating core for plastics or plywood that provides equal strength in all directions and can be routed or drilled close to its edges without splitting is being marketed as Granite Board by the *Aetna Plywood & Veneer Company*, Chicago, Ill. The core board is made of evenly distributed and closely interlocked wood fibers, and the pressed board is smoothly sanded on both faces. It is suitable for paneling and cabinet work and for general construction.

Inorganic Felts.—As an outgrowth of the development work done on glass and quartz papers by the National Bureau of Standards and the Naval Ordnance Laboratory, two new inorganic felts have been developed by the *L.O.F. Glass Fibers Company*, Toledo, Ohio, as resilient and flexible high-heat insulators.

The first of these, called E-Felt, is felted from fine fibers (¾-micron diameter; 0.00003-inch) of borosilicate glass, and is for temperatures up to 1,000 degrees Fahrenheit. Q-Felt, effective as an insulator for operating temperatures up to 2,500 degrees Fahrenheit, is felted from equally fine quartz fibers. The felts are produced by papermaking methods, and no binders are employed. The felts now being offered are 3/16-inch thick in sheets 34 by 71 inches, with a density of about 3 pounds per cubic foot.

Silicone Lubricants.—Two new silicone lubricants requiring no additives to give them the necessary "oiliness" for jet engine and other high-temperature uses are being offered by *General Electric Company's* Silicone Products Department, Waterford, N. Y., as Versilube F-50 fluid and Versilube G-300 grease. Ordinary silicones do not have high oiliness, but the new polymers are about equal in lubricating ability to petroleum products while retaining the wide operating range of the silicones, from minus 100 degrees Fahrenheit to plus 400 degrees.

Nickel-plated Steel.—For processing equipment where contamination must be eliminated, but where corrosive conditions are not too severe, nickel-plated steel sheet and plate are now available. The material costs only about half as much as regular nickel-clad steel. The steel may be plain carbon or low alloy, and the nickel plating can be had on one or both sides. The sheets come in gages 7 to 14 (0.184- to 0.077-inch), and the plate in thicknesses from 3/16 to 1 inch.

The nickel coating on the sheet is 0.006- to 0.008-inch thick, and on the plate it is 0.008- to 0.010-inch, but heavier plates may be had on specification. The nickel plate has a smooth "eggshell" or semigloss surface, is ductile, and has good adherence, the bond strength being about equal to the yield strength of the base metal. It can be welded in the same manner as nickel-clad steel. The sheet and plate are being produced by the Wickwire Spencer Steel Division, Claymont Steel Products Department, of the *Colorado Fuel & Iron Corporation.*

Solar Battery.—The solar battery recently developed by the *Bell Telephone Laboratories, Inc.*, New York, N. Y., is now being manufactured for commercial use by *National Fabricated Products, Inc.*, Chicago, Ill. The silicon crystal wafers are about the size of 50-cent pieces. Each wafer, hermetically sealed, develops an output of 32 milliamperes under direct sunlight.

Silicon Rectifiers.—Bell Laboratories is also one of several industrial laboratories that have been working hard on silicon rectifiers for the past two or three years, and Bell engineers now state that the silicon crystal rectifier has been adequately tested and proved for commercial use. The supply of selenium has been so tight that it has not been possible to stockpile ahead any appreciable amounts for the increasing electronic needs.

But the short supply of selenium was not the only factor in the interest centered on silicon. The increasing demands of the military for lighter weight and greater compactness in electronic devices was impossible to meet with the bulky selenium rectifier. Moreover, compactness and hermetic sealing added to the heat problem, and neither selenium nor germanium could meet the new temperature requirements.

The space-saving possibilities of the silicon crystal rectifier can be judged by the fact that a silicon rectifier will give 5,000 times the current of a conventional selenium rectifier of the same size, and deliver it at 98 per cent efficiency. The silicon rectifier will operate continuously at temperatures up to 400 degrees Fahrenheit, or about double that of the selenium rectifier.

magnesium

Extruded, Cast, Drawn, Welded and Machined

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Make it with magnesium if it must be *light in weight*. Make it with magnesium if you want *easier fabrication*, too!

In this ballistics control housing the advantages of magnesium are being utilized. Extruded, cast and drawn parts are welded into a composite unit, then machined and painted. This is common practice—magnesium provides these same plus values for many manufacturers who consider it a *typical production metal*.

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from under the seas

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Air and atomic power can now go to sea...*under water*. The U. S. Navy today has weapons with striking power beyond imagination...Regulus guided missiles and a growing number of Nautilus class atomic submarines.

Regulus missiles were designed and built by Chance Vought for submarine or surface ship operation. These deadly pilotless "birds" can deliver powerful warheads against enemy targets from hundreds of miles at sea. They have brought *air power* to the underwater fleet...a fleet that is being even further strengthened by atomic submarines able to cruise at high speeds around the world without surfacing or refueling.

Both of these new weapons are prime examples of the vital contributions made by Your New Navy to strengthen the U. S. Defense team.

Regulus saves tax dollars. Most missiles are built to make one flight, but one Regulus model, equipped with landing gear, has flown 15 times! For test and training purposes, this feature means more test data gathered and many more men trained at far less cost.

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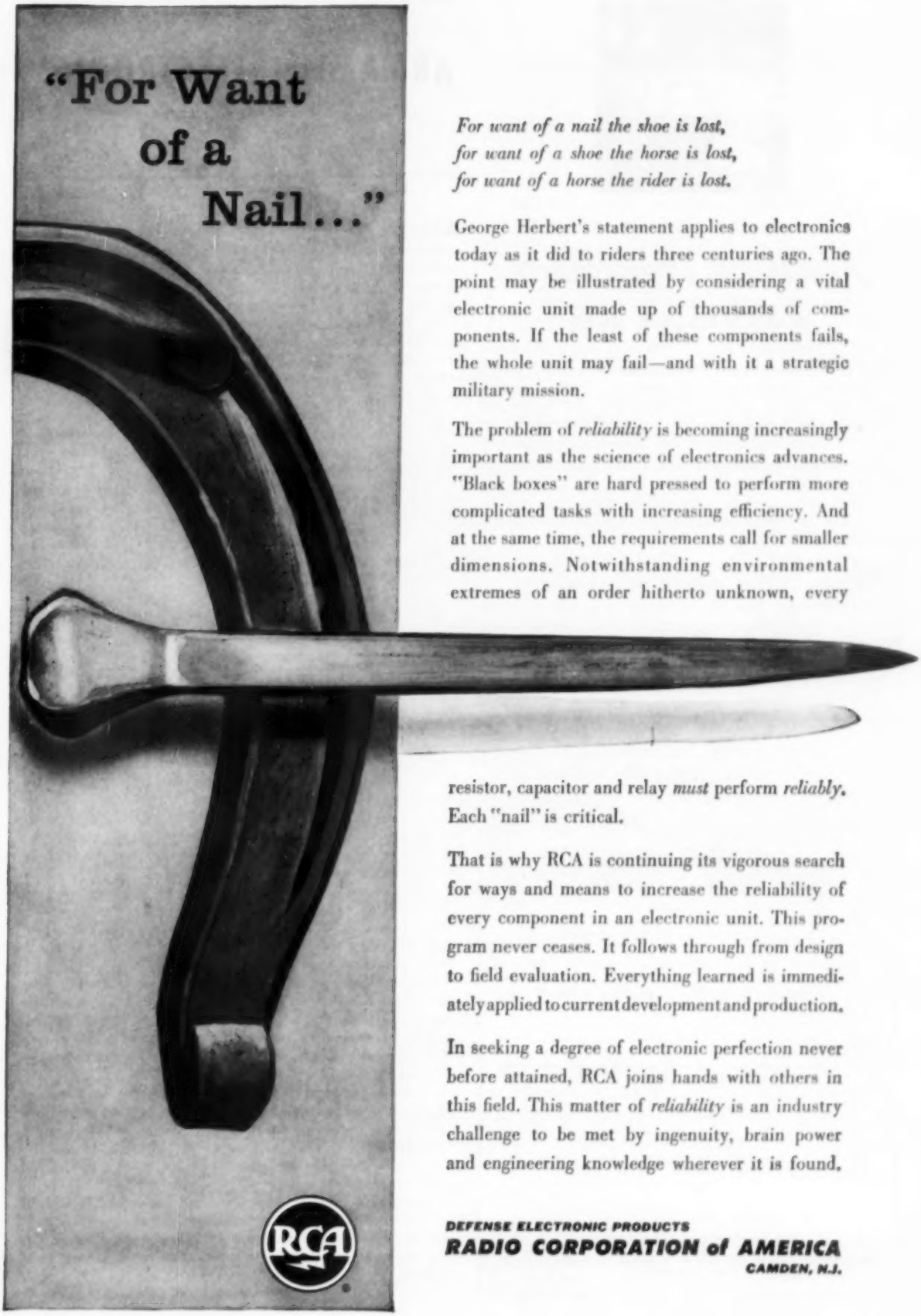

For want of a nail the shoe is lost,
for want of a shoe the horse is lost,
for want of a horse the rider is lost.

George Herbert's statement applies to electronics today as it did to riders three centuries ago. The point may be illustrated by considering a vital electronic unit made up of thousands of components. If the least of these components fails, the whole unit may fail—and with it a strategic military mission.

The problem of *reliability* is becoming increasingly important as the science of electronics advances. "Black boxes" are hard pressed to perform more complicated tasks with increasing efficiency. And at the same time, the requirements call for smaller dimensions. Notwithstanding environmental extremes of an order hitherto unknown, every resistor, capacitor and relay *must* perform *reliably*. Each "nail" is critical.

That is why RCA is continuing its vigorous search for ways and means to increase the reliability of every component in an electronic unit. This program never ceases. It follows through from design to field evaluation. Everything learned is immediately applied to current development and production.

In seeking a degree of electronic perfection never before attained, RCA joins hands with others in this field. This matter of *reliability* is an industry challenge to be met by ingenuity, brain power and engineering knowledge wherever it is found.

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Life Membership is not transferable.

The Life Membership fee may be deducted for Federal income-tax purposes.

L-103

ARMAMENT ELECTRONICS

Dr. W. S. Carlson

FREQUENT appearance of papers in the periodical literature, supplemented from time to time by the published proceedings of conferences dealing with operational reliability of electronic armament, attest to the vigorous interest of the armed services in this aspect of equipment performance.

By their sponsorship of symposia devoted to discussions of quality control and operational reliability, industrial organizations and several professional societies, including the American Ordnance Association, have emphasized the importance of work in these fields for progress in electronic technology.

Review of the literature pertaining to reliability discloses a diversity of opinion as to formulation of problems and proposals for remedial action. Analyses and recommendations based on statistical considerations are frequently encountered.

At the risk of oversimplification, the central concept of this approach is, by inverted paraphrase of a familiar aphorism, that there are no unreliable systems but only unreliable components. Given mortality data for the various types of components incorporated in an equipment, its reliability can be predicted by statistical inference.

This line of reasoning leads to the truism that, in general, reliability of an equipment is inversely related to its complexity; *i.e.*, the number of component parts.

A component mortality function of the form $n = n_o e^{-k_C t}$ is usually assumed, in which the number n of components remaining in service out of the original quantity n_o declines exponentially with time. The constant fraction k_C is termed the component failure rate or, reciprocally, the mean life expectancy. By summation of component rates a failure rate k_E, or survival probability $P = e^{-k_E t}$, can be ascertained.

An illustrative computation, based on parts-mortality data compiled by Rand, Inc., was presented at a recent symposium sponsored by the U.S.A.F. and the Radio Corporation of America. For an electronic equipment comprising 2,400 components, including 200 tubes, a mean life expectancy of 64 hours between failures was computed.

It was pointed out that, with a mean life of 64 hours, less than 5 per cent of equipments could be expected to survive a 200-hour-life test. In order to make 200-hour survival the rule rather than the exception, reduction of component failure rates by an order of magnitude or more will be necessary.

That reliable equipment implies reliable components is true but trivial. Specification of the allowable failure rate is of little practical significance beyond determining the sample size required for component inspection. Improvement of components and development of efficient inspection procedures are essentially engineering tasks.

Recourse may be had to statistical techniques for verification of engineering conclusions and for evaluation of improvements in components, equipment design practices, and field-maintenance procedures.

In short, reliability problems may be stated but will not be solved in statistical terms.

Undue preoccupation with component failure rates without sufficient attention to the circumstances and mechanism of failure has led equipment producers to impose more stringent, but not necessarily more relevant specifications on electronic components.

(*Continued on p. 680*)

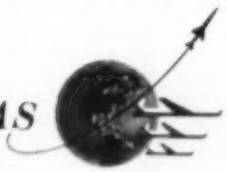
New missile marches with the infantry

Modern foot soldiers do more riding than walking. Trucks, tanks and parachutes give the infantry high-speed mobility that calls for equally mobile support weapons.

One such weapon is Honest John. Developed by Douglas in co-operation with Army Ordnance, this new missile is a free-flight rocket without complicated guidance system. It moves quickly into position on a special truck that serves both as transport and launcher. Highly accurate, Honest John can handle either a nuclear warhead or a single explosive round of enormous power.

The U.S. Army's Douglas-Designed HONEST JOHN Artillery Rocket

Defense is everybody's business. Development of Honest John by Douglas is an example of industry's role in U.S. defense. But weapons need people to make them work. The Army needs young men and women who agree that "defense is *everybody's* business."

Depend on *DOUGLAS*  **First in Aviation**

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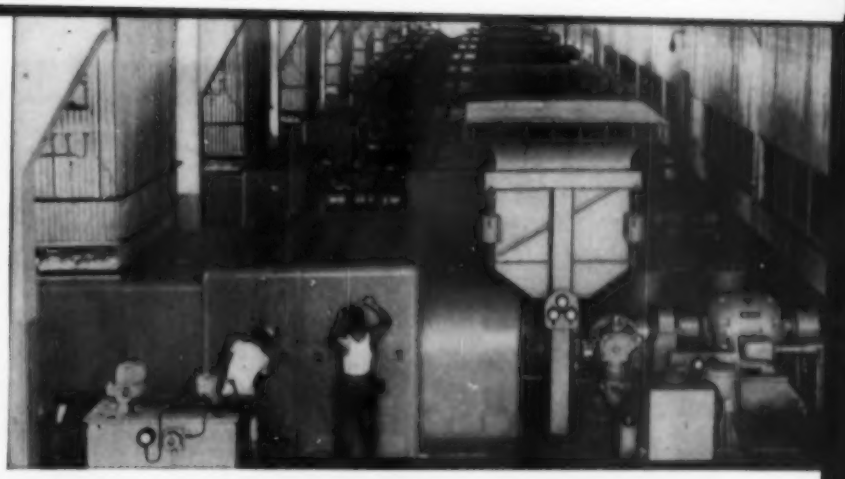
Vital Controls

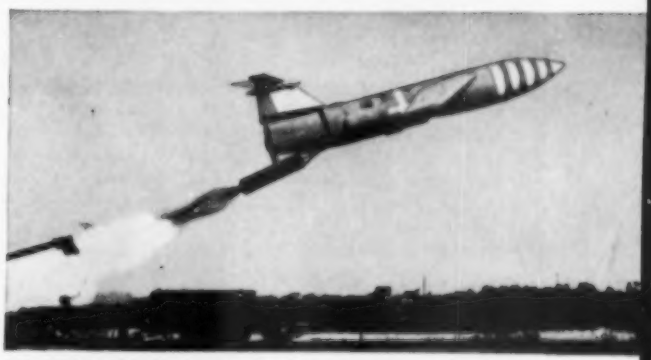
The controls on the world's fastest submarine; the most advanced airborne navigation system known to exist; other similarly advanced military systems and equally advanced industrial equipment and control systems are outstanding examples of the work of the producing companies of General Precision Equipment Corporation. More than a dozen major industries are served by instrumentation and systems designed, developed and produced by GPE Companies.

Ten of the companies in the GPE Group—notably Askania, Kearfott, Librascope and Link Aviation—devote substantial resources to the development and manufacture of instruments, servos and controls. These are used in equipment and systems developed by these companies



PROCESS CONTROL—Askania controls regulate speed of the ten turbines which develop compression to maintain gas suction pressure in Creole Petroleum Corporation's giant, pile-supported oil drilling operation on Lake Maracaibo, Venezuela.

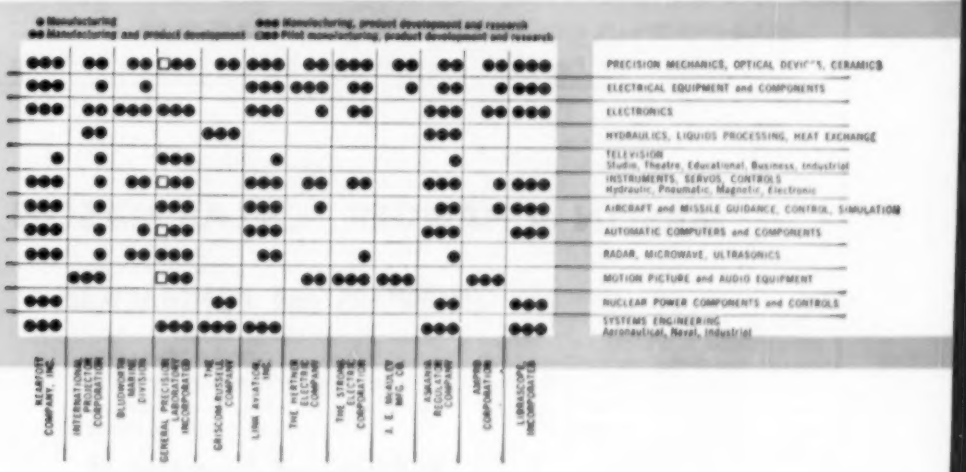
SUBMARINE OPERATION—Controls developed and produced by Askania Regulator Company are utilized to govern operation of U. S. Navy's modern Guppy type submarines.



MISSILE GUIDANCE—One of the many guided missiles equipped with Kearfott basic gyro reference systems, the B-61 Matador—U. S. Air Force's first successful ground-to-ground tactical weapon.

GPE

CAPACITIES



themselves, as well as in systems and equipment developed and produced by other manufacturers of advanced technological equipment.

All GPE Producing Companies work in the advanced areas of highly specialized fields and are engaged in the design, development, manufacture and sale of equipment which is closely related from a technical point of view. It is all precision equipment; it derives from similar fields of technical competence; it saves labor, increases productivity or achieves results which cannot be achieved with even limited use of on-the-spot manpower. The chart here shows the specialized fields in which the key GPE Producing Companies work.

In addition to specialization in its particular products and fields of technical competence, each of these companies has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation of their resources is achieved through GPE's basic operating policy, GPE Coordinated Precision Technology. In all areas in which GPE Companies work, this coordination has been responsible for a wide variety of precision equipment of superior design and performance, embodying new, advanced principles.

A brochure relative to the work of the GPE Companies and GPE Coordinated Precision Technology is available. Address your request, or specific inquiries, to: GENERAL PRECISION EQUIPMENT CORPORATION — 92 Gold Street, New York 38, N. Y.

As an illustration, the life test provision of the specification MIL-S-12472 (Ord) pertaining to synchros may be considered. Experience has shown that bearings occasionally develop excessive friction torque after a few hours of operation. Instances of premature electrical failure due to arcing between brushes and slip rings also have been encountered. Because these defects become evident only after a period of service, incipient failures cannot be detected by measurement of friction torque and contact resistance on new units.

A 1,000-hour endurance test, in which the rotor was driven mechanically at 1,150 r.p.m., was therefore written into the specification as a vendor qualification test. This approach was successful in the sense that from time to time qualification samples which had passed all other tests developed excessive friction torque after a few hours on the endurance test fixture. In consequence of the time required, the endurance test obviously could not be adopted for routine inspection.

With a view to preventing or devising a more efficient method of screening latent defectives, the mechanism of failure was investigated. Examination of bearings disclosed that aggregates of anodized aluminum, derived from interior surfaces of the case, accumulated in the bearings. Synchros not anodized on interior surfaces, or anodized synchros from which the coating had been removed over critical areas showed no torque increase during life test.

Demand for increased reliability is, unfortunately, likely to become acute only after production equipment is placed in service. On being abruptly confronted with this situation, an equipment manufacturer can be expected to impose more or less proprietary specifications and special inspection procedures on component vendors. Although clearly incompatible with the philosophy underlying promulgation of coördinated military standards and specifications, current examples of this practice can readily be found.

In general, crash programs involving an attempt, by selective acceptance of purchased parts or other special processing, to shift the burden of improving reliability to the components is apt to meet with limited success. If adopted as an emergency expedient, it is essential that agreements between the equipment manufacturer and component vendor as to special tests and requirements be made a matter of record in the form of drawings or other appropriate documentation. Unless this is done, difficulty will be experienced in provisioning spare parts for field maintenance.

When it becomes clear that a real improvement in component quality has been achieved—*i.e.*, an improvement not attributable solely to selection—revision of the pertinent military characteristics should be proposed.

Random failure (exponential decrement), widely accepted as characteristic of electronic components, probably reflects conditions of service rather than intrinsic properties of the components. There is no obvious reason why a sealed transformer operated within its ratings should not exhibit an indefinitely long service life.

Failure is usually attributable to antecedent failure, such as an internal short in a rectifier tube, elsewhere in the system. Resistor failure in circuits designed with due regard for ratings likewise reflects failure elsewhere in the system. On the other hand, life expectancy of some types of capacitor and of thermionic tubes is limited by intrinsic factors.

To know only the failure rate of a transformer is of little help to the engineer wishing to improve system reliability. It is essential that the circumstances of failure be known. This requirement implies a system of reporting which goes beyond mere tallying of failures. The procedure established by AR 700-39, which requires a report on every component failure in specified equipments, is a major step forward.

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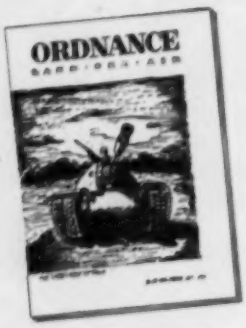

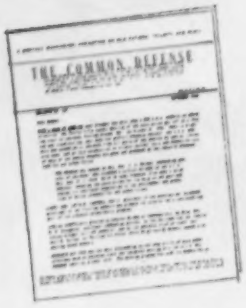

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ROCKETS AND GUIDED MISSILES

Alfred J. Zaehringer

Astronautics.—The Department of Defense recently awarded a contract for the construction of the rocket components of *Vanguard*, the new earth satellite rocket vehicle. Under this contract, General Electric is to develop and supply the rocket power plant while the Glenn L. Martin Company is to construct the "airframe."

Although it was expected that the satellite might be constructed from our Atlas program, present bifurcation from the weapons program indicates that a clear track is desired for our intercontinental ballistic missile program. It is now envisaged that the satellite rocket will be made up of three or four individual rockets (stages) stacked on each other. The multistage rocket would weigh on the order of fifty to one hundred tons and be nearly one hundred feet in length.

Whether one large engine or several smaller rockets will be used for the launching stage is not known, but the total power generated by the first stage will be in excess of that generated by Hoover Dam. It is probable that launching will take place in the direction of the earth's rotation (eastward) to gain additional velocity.

Although the launching site has not yet been named, only two American sites can meet the necessary requirements. One is at the White Sands Proving Ground, but the possibility that one or more expended stages may return to impact points within the United States and outside the proving ground range limits may rule out this New Mexico location.

A more likely site is the Air Force Long Range Proving Ground at Cocoa, Fla. In addition to providing safe areas for expended stage impact, there is the added feature that existing tracking and control stations extend eastward into the Atlantic Ocean. The first stage will lift the upper stages to an altitude of ten to forty miles and then drop off. After this initial vertical blast-off to penetrate quickly the denser portions of the atmosphere, the remaining stages will be tilted downward at an angle and the next stage fired. This firing would carry the rockets to an altitude of forty to one hundred miles when the second stage would drop off.

The remaining rockets would then coast to an altitude of 200 to 300 miles. When the remaining stages had reached the proper position (possibly parallel to the earth), the rockets would again be fired to bring the satellite portion to a speed of 16,000-18,000 miles an hour.

At these speeds and altitudes the rocket would have attained satellite velocity. In other words, it would fall to the earth while the earth would "fall" or rotate away from the rocket at the same rate, thus allowing it to remain in an orbit around the earth.

Because of speed and position errors and because the satellite would still be subject to gravitational and slight frictional forces, it would eventually be drawn back to the earth. The time required for this return would be weeks or perhaps months but should allow for data gathering and observation before its destruction on its trip back to the surface.

The original $10 million mentioned in the satellite statements are expected to be concerned with the last stage, its instrumentation, and the ground problems associated with the data-gathering and processing systems. As it now stands, each satellite may cost $25-50 million. There is also the possibility that more than one satellite launching may be attempted during the 1957-1958 International Geophysical Year.

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Contacts picked up by these DEW line (Distant Early Warning) radars are flashed to Air Defense Command centers.

The U. S. Air Force and Western Electric, contractor for the DEW line, selected Raytheon to develop radar for these critical Arctic stations. We are proud of this choice and of our opportunity, as the world's largest producer of search radar, to contribute to the protection of our hemisphere.

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Rockets and Guided Missiles

Missiles.—The new Air Force missile, *Falcon*, GAR-98, is undergoing extensive testing before becoming a part of America's new missile family. Falcon, with airframe and guidance by Hughes Aircraft, is currently being produced in Tucson, Ariz. Power for the GAR-98 comes from a high-performance solid-propellant rocket which was developed by Thiokol Chemical Corporation. Falcon weighs about 110 pounds and is about 6 inches in diameter.

The air-to-air missile was designed for use with the Convair F-102 delta-wing jet interceptor. The entire system is described as a manned missile combination. Ground-control systems warn of approaching air targets and a pilot takes off the Falcon-armed F-102.

Automatic guidance then flies the airplane to the vicinity of the target where guidance and controls within the aircraft take over, orient the plane, fire the rockets, and guide them automatically to the target despite evasive maneuvers on the part of the target aircraft.

With its mission over, the guidance system brings the jet aircraft back to home base where the pilot can land it. Present production cost of the Falcon is from $25,000 to $50,000 each with costs expected to drop to about $15,000 in mass production.

Another missile, the Navy *Terrier*, has received extensive testing. The 2-stage rocket is about fourteen feet long and has a diameter of twelve inches. Estimated speed of the 3,300-pound missile is about twice the speed of sound.

Two other guided-missile ships, the U.S.S. BOSTON and CANBERRA are playing host to tests of another weapon—*Talos*. Talos was developed by Bendix, McDonnell, and RCA for the Navy as a long-range surface-to-air missile and has a potential for development as a bombardment rocket for Marine Corps amphibious operations.

Four new missiles have been revealed. *Crossbow* is a missile of undisclosed capabilities which is to be manufactured at the Northrop Aircraft plant in El Paso, Tex. *Sidewinder* is a new Navy air-to-air missile which may prove to be one-tenth the cost of the present Sparrow or Falcon. The Air Force has indicated that it plans to augment its intercontinental missile program by developing another missile of *Atlas* capabilities (about 5,000-mile range).

The increased effort is a result of National Security Council conclusions that the Soviets have been engaged in intercontinental missile programs since 1945 and may have a large number of hydrogen-armed rocket missiles by 1960-1965. Meanwhile, the RV-A-10 missile, developed by General Electric Company and other industrial firms for Army Ordnance, is stated to be one of the world's largest solid-propellant rockets designed and flown.

Propulsion.—New rocket propellants were discussed at a recent American Chemical Society meeting at which W. F. Arendale, Thiokol Chemical Corporation, Huntsville, Ala., discussed the versatility of composite propellants. A composite propellant is a mixture of a fuel binder and an inorganic oxidant salt. Organic polymers are proving useful for the fuel binders since they provide good physical properties, low cost, high availability, and simple processing.

In the field of liquid propellants, J. G. Tschinkel, Redstone Arsenal, Huntsville, Ala., revealed that tetranitromethane has good possibilities for rocket systems. Chief merits are high specific gravity (1.64), high oxygen content (69.5 per cent by weight), and good storage properties. In some instances it could compete with liquid oxygen. Tetranitromethane can be used as a monopropellant or with another fuel.

Two drawbacks are: high freezing point (57 degrees Fahrenheit) and its sensitivity to explosion. Although the successful replacement of liquid oxygen with liquid ozone (LOZ) would allow substantially increased rocket performance, LOZ has proved very difficult to handle.

"CLIP-TYPE" closed entry socket contact now standard in

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Industry has also been plagued with overstressed spring leaves due principally to the misuse of test probes and lax tolerances on pin contacts. Bendix engineers now provide the only socket contact which completely eliminates all these problems.

The "Clip-Type" socket will not accept any oversize probe or pin, nor can one be forced into it. Also, no amount of wrenching or twisting of an acceptable pin or probe can possibly distort the spring clip. This new socket is now standard in all Scinflex connectors including those using solderless, high-temperature and thermocouple contacts.

Complete detailed information is available on request.

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RECENT PATENTS

This department on recent military-industrial patents is being published in ORDNANCE *to keep our readers informed of the latest developments in these fields. The data are compiled by Melvin Nord, patent attorney, Detroit, Mich. Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each.*—THE EDITORS.

NET GATE FOR HARBORS

• *U. S. Patent No. 2,716,959. Issued September 6, 1955, to George E. Betts, Jr., Elmer L. Blekfeld, and Arthur T. McCanner, Jr. Assigned to the Secretary of the Navy.*—This invention provides a net gate to provide protection for marine harbors against submarines or torpedoes. One of the objects of the invention is to provide a construction in which the upper edge of the net is buoyantly supported above the surface of the water so that shallow or surface-running objects are intercepted. Each panel of the net is supported by a number of spherical floats which are interconnected at top and bottom by short jackstays.

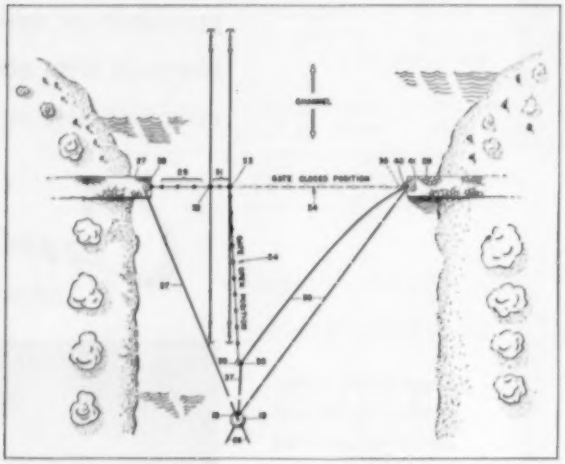


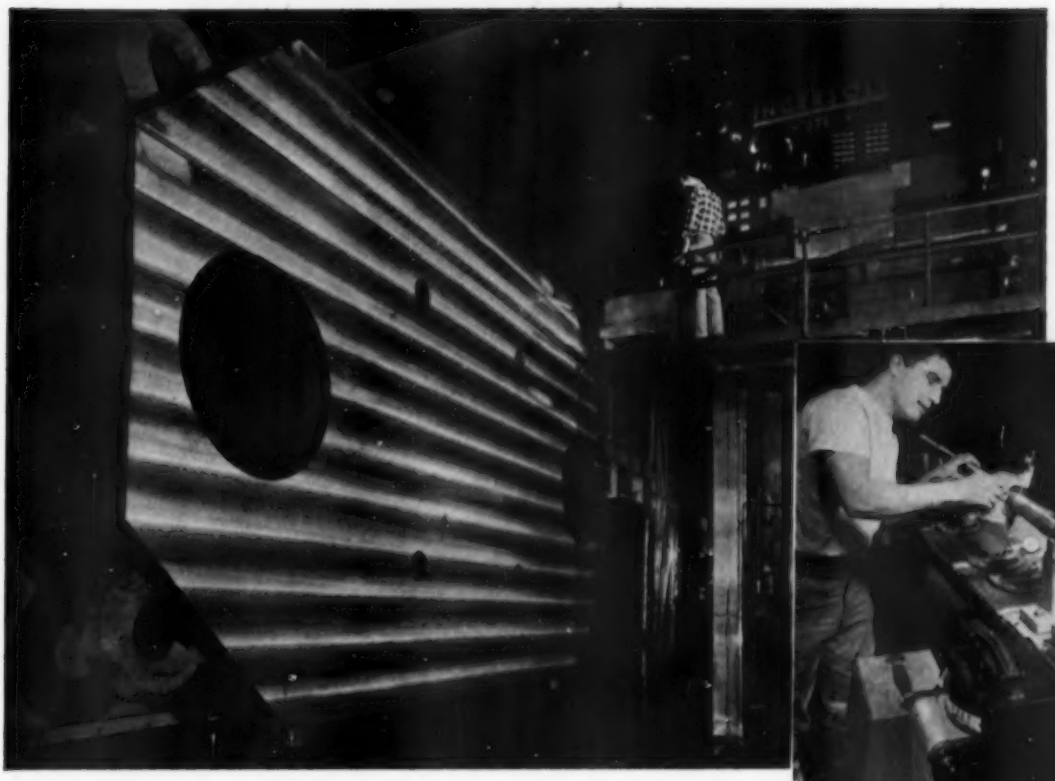
Fig. 1. Net gates in open and closed positions.

As shown in Figure 1 there are two breakwaters 27 and 28 with a gap between which is closed by fixed apron panels 29 and 31 moored by anchored portions 32 and 33 and by a movable gate 34. A peg-type buoy 18 is moored by anchorages 26. At the free end of the gate is a spherical float 35 provided with a ring 36 to which is secured the gate-opening rope 37 and gate-closing rope 39.

The gate is opened by reeling in opening line 37 by operation of a winch 38 and paying out closing line 39 until it rests on the harbor bottom. The gate is closed by reeling in rope 39 by operation of a winch 41 and paying out the opening rope 37.

PERFORATING PROJECTILE

• *U. S. Patent No. 2,717,552. Issued September 13, 1955, to Edgar W. Brandt. Assigned to Anstalt fur die Entwicklung von Erfindungen und Gewerblichen Anwenden "Energa" (Leichtenstein).*—This patent describes a projectile which is especially efficient against armor. It is so designed that, at the moment of im-



Mass and precision: *At left,* a large horizontal boring mill at Bliss' Canton plant is used to finish machine 200-ton weldment for 25,000 ton press. *Directly above,* an electronic recording gage checks three separate tapers in the chambers of barrels for 20 mm machine guns. Tolerances are held to 0.002".

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pact of the shell, a load of explosive contained in the shell ejects a perforating core at very high speed and point-blank range against the target.

ROCKET LAUNCHER

• *U. S. Patent No. 2,717,534. Issued September 13, 1955, to Henry F. Atherton, Jr.*—This patent provides an apparatus for automatically and continuously firing a series of rockets. Successive rockets are automatically transferred from a magazine to a firing tube by means of the exhaust gas from previously ignited rockets.

PROPELLING DEVICES

• *U. S. Patent No. 2,717,744. Issued September 13, 1955, to Arnold Birnbaum. Assigned to the M. W. Kellogg Company.*—This patent provides a number of structural improvements in missile-propelling devices, making the maximum practical use of the available kinetic energy of the propellant fluid and permitting efficient operation over a wide range of velocities and especially low velocities.

COMPOUND JET NOZZLE

• *U. S. Patent No. 2,716,528. Issued August 30, 1955, to David M. Hammock.*—This patent discloses the use of compound jet nozzles mounted on the wing of aircraft either for propulsion or for lift. The compound nozzle is shown in Figure 2. Here 1 is a portion of the main body of the craft being propelled, 2 is the high-

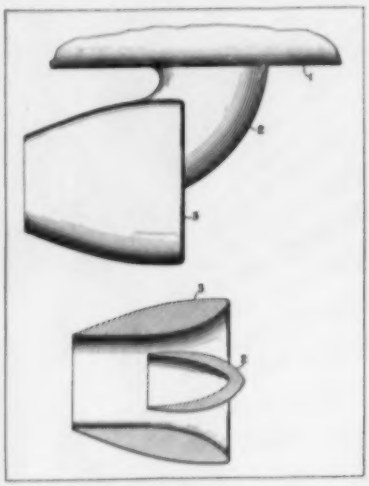

Fig. 2. Diagram of compound nozzle.

pressure supply pipe for the inner nozzle combined with fairing, forming the support for the outer induced-flow nozzle 3.

According to the inventor, the compound nozzle produces more thrust than the simple nozzle. He states that it should be particularly useful for cargo aircraft by increasing the lift of the wing.

PYROTECHNIC COMPOUND

• *U. S. Patent No. 2,700,603. Issued January 25, 1955, to David Hart, Henry J. Eppig, and William J. Powers.*—Pyrotechnic compositions such as are used in flares, signals, smokes, and tracers must normally be pressed into suitable cases at pressures ranging from 2,000 to 110,000 p.s.i. in order to obtain smoothness of burning as well as resistance to handling or impact.

The necessity of pressing can be avoided by incorporating five to forty per cent of a liquid plastic, such as dichlorstyrene, in the composition together with a catalyst such as lead peroxide, cumene hydroperoxide, or stannic chloride. In addition to acting as a binder, the plastic material regulates the burning rate.

CRIMPING DEVICE

• *U. S. Patent No. 2,697,376. Issued to Glenn R. Dixon. Assigned to Olin Mathieson Chemical Corporation.*—The patent describes an apparatus for crimping blasting caps or detonators uniformly and continuously around the shell without twisting the leads, by the rolling action of a crimp wheel.

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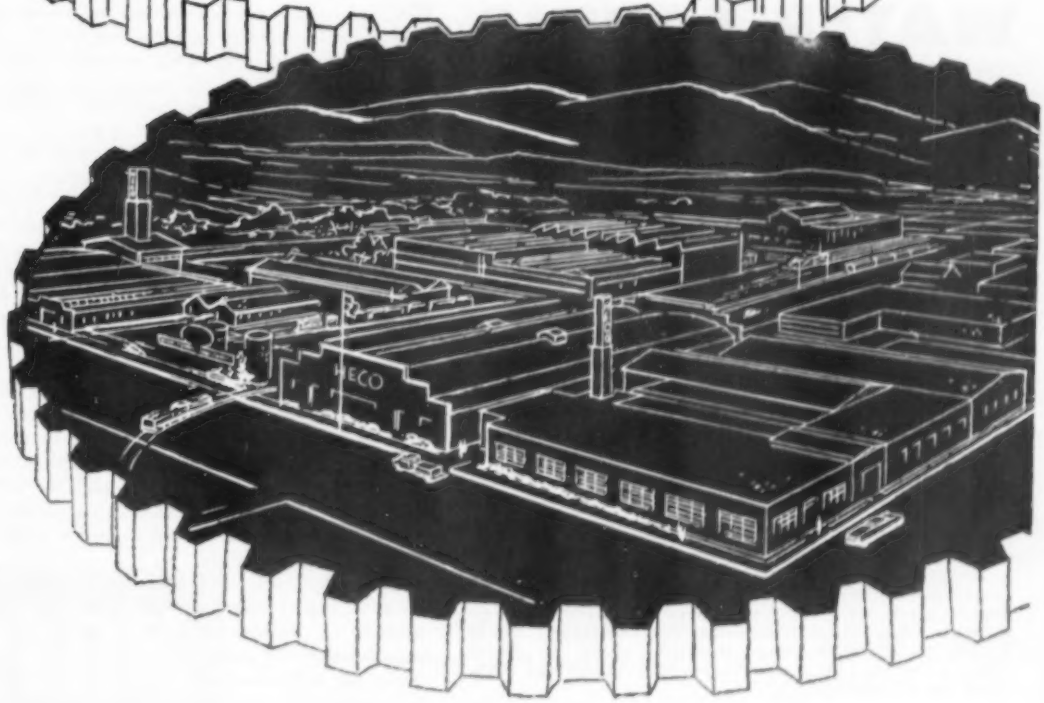

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Book REVIEWS

Reviews in this issue by:

COL. LEO A. CODD, *editor,* ORDNANCE *magazine, Washington, D. C.*

COL. JOHN J. DRISCOLL, *author, air armament engineer, NATO, Paris, France.*

DR. JAMES B. EDSON, *consultant on electronics, Research and Development Division, Office, Chief of Army Ordnance, Washington, D. C.*

COL. G. B. JARRETT, *curator, Ordnance Museum, Aberdeen Proving Ground, Md.*

BRIG. GEN. THOMAS K. VINCENT, U.S.A., Ret., *artillerist, engineer, author, Washington, D. C.*

CAPT. J. M. P. WRIGHT, U.S.N., Ret., *naval ordnance engineer, logistician, editor, Washington, D. C.*

The Call to Honour—The War Memoirs of General de Gaulle, 1940-1942. New York: The Viking Press. 319 pp. $5. (A 2-volume edition containing both the narrative and translations of all supporting documents is also available, boxed, at $10.)

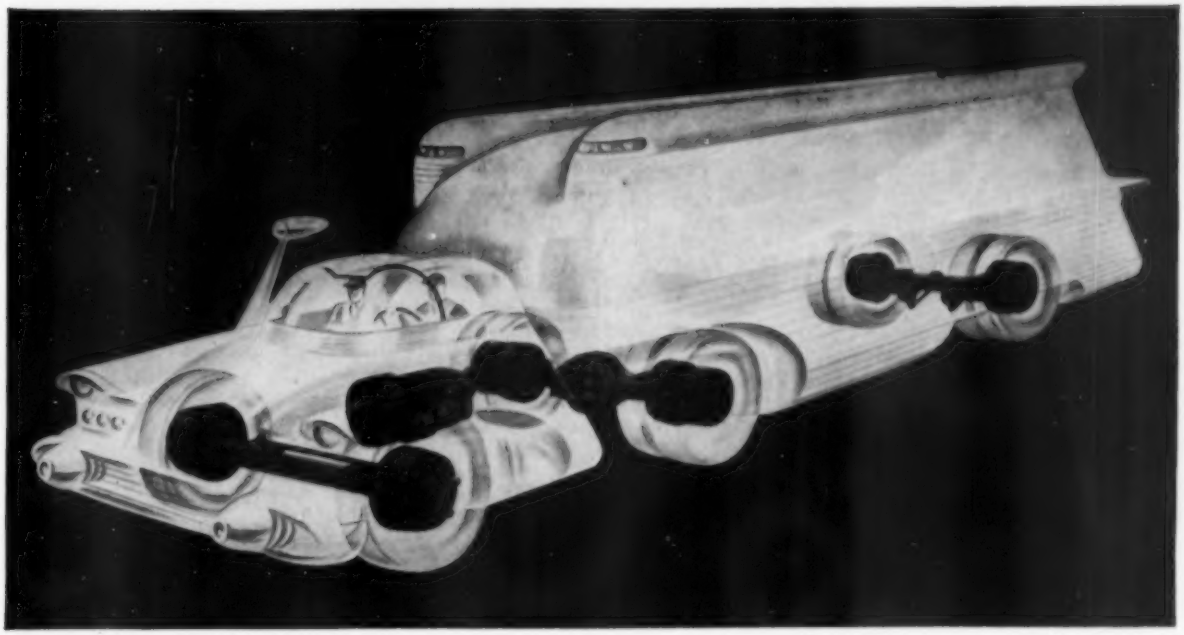
THE man who embodied the best of France for four stark years of national travail now presents for the record detailed accounts of his own battle for his native land. General Charles de Gaulle in his memoirs portrays with simple, moving candor the forthright philosophy and patriotic fervor of the great French soldiers of all times.

This book describes many of the political incidents of world-shaking significance which were characteristic of the days when France was falling and of the rise of Free France during the German occupation. But the principal significance of the book for ordnance students is General de Gaulle's faultless stand for mechanized, mobile armies. Irrespective of his place in history among military-political leaders of the first half of the twentieth century, he cannot be denied his uncontested position as a leader among the few who have stood for mobility on the battlefield.

Thus the early pages of this book describe in detail his ceaseless but unsuccessful struggle for the mechanization, modernization, and mobility of the French Army against all the entrenched views of the Maginot-Line mind. Many of De Gaulle's superiors in the French Army, contrary to all French tradition, were wedded to the principle that Germany could be held off through fixed fortifications. Their eyes were completely closed to the terrific power of blitzkrieg and its potential for quick victory over position-minded forces.

In his earlier book, "The Army of the Future," which did not appear in English translation until 1940, General de Gaulle was crusading for mechanized armor of great striking power and fast movement. His words then fell upon deaf ears, not only in France but in England and the United States as well! Only in the German Army was the new philosophy seized upon and put into actual effect in both matériel and training—with the results shown only too well in the Second World War.

Hence these memoirs by a renowned general of France have



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Book Reviews

special meaning to all students of armament the world over. Again are vindicated the pleadings of that small group who strove for speed, armor, mobility, and striking power at a time when military as well as political thinking was lulled by the attractions of static warfare.

What Guderian and Rommel stood for successfully in their demand for mobility in Germany; what Fuller and Liddell Hart pleaded for in vain in England; what Williams, Chaffee, and Patton insisted upon in the United States—De Gaulle pioneered in France.

Luckily England and the United States did not fall as did France, but all paid a terrific price. Only the German Army scrapped the trench-warfare concept and prepared to fight battles of fast, powerful movement. The lesson for those who have come after is clear for all to read.—Leo A. Codd.

Hellcats of the Sea. By Vice Adm. Charles A. Lockwood and Hans Christian Adamson. New York: Greenberg, Publisher. 335 pp. $5.

THE story of U. S. submarine exploits in the last war has been recounted briefly in the Navy Department's report on our submarine losses in World War II, described in a few individual stories, and dramatized on the screen. Now the wartime commander of our submarines in the Pacific relates one phase of the operations that he lived with day and night for over three years.

The Hellcats were equipped, trained, and operated for the dangerous mission of penetrating the Sea of Japan and cutting Japan's last link with the mainland. Secure behind complex minefields, the Emperor's vessels plied their "private" sea fully lighted, while on the remaining oceans and seas of the world all ships steamed stealthily blacked out.

The operation was made feasible by a special FM-type radar for mine detection that had been diverted from the minesweepers by Admiral Lockwood's persistence. The Admiral then lent a hand personally in training his submarine skippers to use the device effectively.

The accounts of the eight boats that returned (nine went in) are given in full and should make every reader proud of the alertness and courage of the submariner.—J. M. P. Wright.

The Mind of Napoleon. Edited and translated by J. Christopher Herold. New York: Columbia University Press. 322 pp. $5.

POSSIBLY some other student of Napoleonia has done a similar thing to that presented here. However, your reviewer, being a casual reader with catholic tastes as to subject, is unaware of similar books. Mr. Herold has taken all of Napoleon's written and spoken words, carefully selected those opinions which were pertinent to the thirteen general themes he had established, translated them into English, and then assembled them in logical continuity. As a result we have, in over 300 different sections, the opinions of this near-legendary figure on almost every subject.

Napoleon was a remarkable man, but he was not infallible. He was not right in all his opinions nor successful in all his undertakings, as history so accurately records. But he was a fascinating personage, and his views on any subject are worthy of attention, if only to be rejected.

Covering subjects such as, Questions of Life, Destiny, and Greatness; Law and Social Order; Church, School, and Press; The Tyrant Speaks, to name a few, I found this book well worth reading and owning. The clarity and the exactitude of his expression, and the earnestness with which he adhered to his chief doctrine—"that his destiny must be fulfilled"—causes the reader to pick up the book for a few moments of contemplative reading and put it down hours later.—Thomas K. Vincent.

National Seamless Tubes

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of Navy Jet's guns

NATIONAL USS Stainless Seamless Tubes are being used as gun blast tubing on the F2H-3, a McDonnell jet interceptor. The actual gun openings shown on the photograph are castings. But directly behind them, mounted over the machine guns' muzzles, are the gun blast tubes.

The job of the blast tube is to restrain high pressures caused by the firing of the gun, and to prevent the backflow of muzzle gases into the plane itself. These gases are highly explosive, and must be kept from the inside of the plane.

Previously, the 1 7/16 OD x 1 1/8" ID gun blast tubes were machined from bar stock. National Seamless Tubing, however, pierced from solid billets of USS Stainless Steel, affords the absolute uniformity of wall strength required for such a heavy-duty application.

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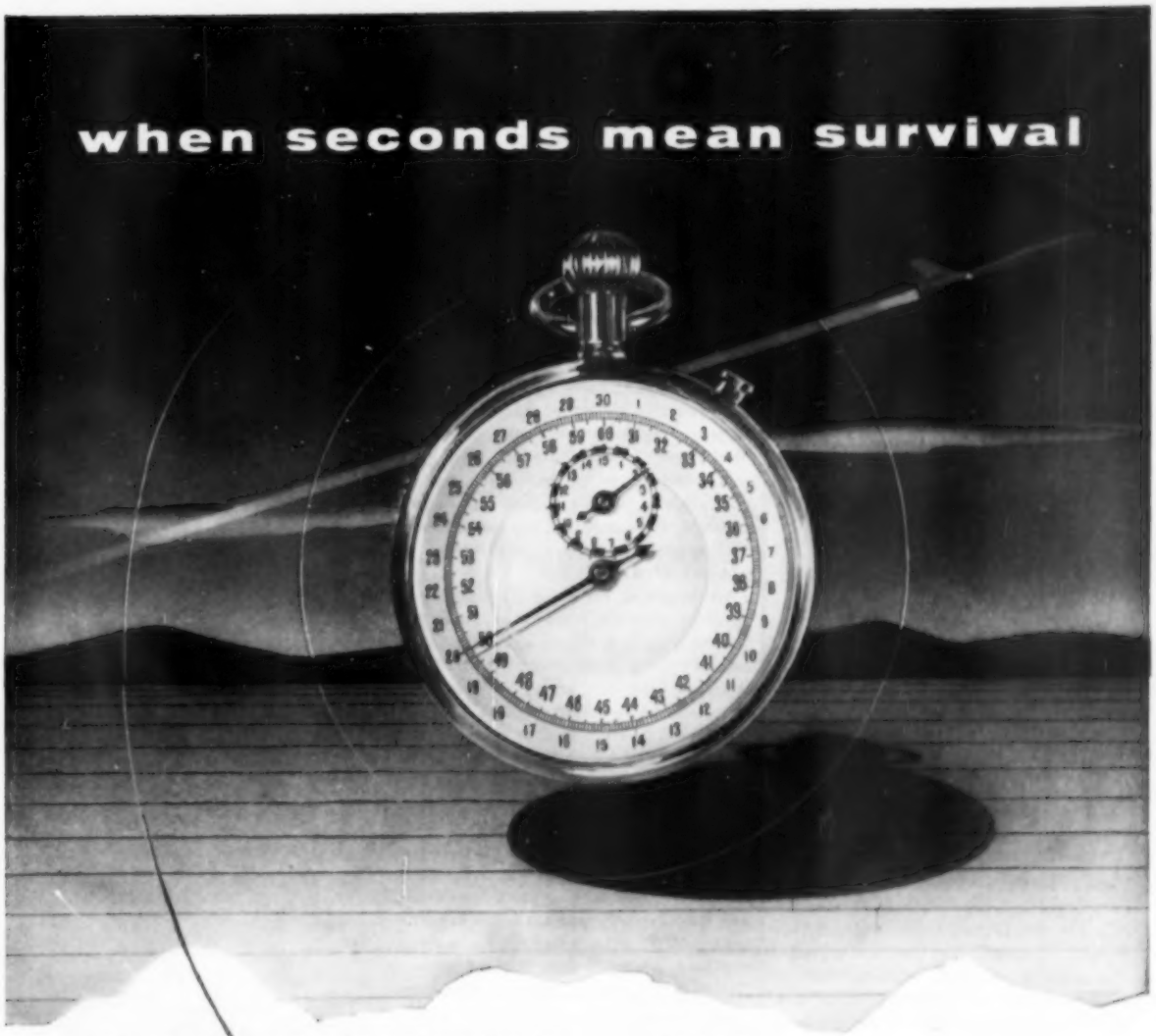

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Book Reviews

So Full a Glory: A Biography of Marshal de Lattre de Tassigny. By Maj. Gen. Sir Guy Salisbury-Jones. New York: Frederick Praeger. 288 pp. $5.

MARSHAL de Lattre's last great military effort for France was in Indo-China against Viet-Minh in 1951. He died in Paris, January 9, 1952. Of him Field Marshal Montgomery wrote, "Marshal de Lattre was a brilliant soldier, but he was more than that; he was also a statesman."

The excellent book by General Salisbury-Jones is a detailed narrative which portrays on every page the bases for Montgomery's high estimate. De Lattre was a commander of exceptional perception, a leader of troops in the best French tradition. His campaigns, his methods, and his personality were a combination of persistency and audacity.

He fought at Verdun and in other campaigns in the First World War. He fought the losing fight of France against the German blitzkrieg in the Second World War. After the fall of France, he escaped to join General de Gaulle and to lead the French First Army back to victory. After that conflict he joined Montgomery in setting the stage for peace in Western Europe, although the De Lattre-Montgomery relations were far from peaceful!

When Viet Nam was under attack in 1951, Marshal de Lattre was assigned to direct the operations of the armies there, and there his only son was killed in battle.

One of the most interesting portions of the book describes the relations between Marshal de Lattre and the American commander, Gen. Jacob L. Devers, during the latter's brilliant conduct of the Battle for France. That the two strong personalities worked together so successfully was due in large measure to the rôle of Col. Henry Cabot Lodge who was on General Dever's staff and whose ability as an interpreter smoothed the way for two born leaders to get along with the task in hand and win. —LEO A. CODD.

The Secret Raiders. By David Woodward. New York: W. W. Norton & Company. 288 pp. $3.75.

THE merchant raider is the terror of the sea to the ocean-going ship in wartime. Submarines normally operate on selected sea lanes and tackle convoys, but the surface raider roams the high seas usually in the guise of a neutral merchantman and picks off single ships.

In World War II Germany sent out nine armed merchantmen which sank more shipping than the German cruisers at sea or the aircraft and minefields in North Sea waters. All the raiders had exciting tales to log in the Nazi's historical record, including two gun battles that ended in both ships being sunk. In one of these duels the American Liberty ship, STEPHEN HOPKINS (one 4-inch gun) fought to the death with the STIER (six 5.9-inch guns, four light antiaircraft guns, and 4 torpedo tubes).

This is a lively series of sea stories from the German records that comprise a little-known but exciting aspect of the war. —J. M. P. WRIGHT.

The Luger Pistol. By Fred Datig. Beverly Hills, Calif.: Fadco Publishing Company. 208 pp. $7.50.

THIS is the first book presenting the complete and authentic story of the famous Luger pistol. The thorough presentation of the background material indicates that the author took great pains in his research in order to present an accurate story.

The fascinating account of the evolution of the Luger unfolds from the earliest Borchardt pistol to the last specimens assembled after World War II. The average reader will surely be amazed when he learns of the great number of types, models, and variations of this weapon. In addition to the historical background, the author also has given the reader a clear picture of the mechanical workings of the pistol itself.

Any one interested in the arms field will find "The Luger Pistol" a valuable reference work. It is truly a fine contribution to the field of arms literature.—G. B. JARRETT.

The Theory of Aëroelasticity. By Y. C. Fung. New York: John Wiley & Sons, Inc. 490 pp. $10.50.

THIS text gives the student an engineering insight and a basis for modern engineering computations in aëroelasticity. Steady-state deflections, flutter, and gust loading are among the topics treated. The book does not discuss the effects of explosive shock waves.

Mathematical background in dynamics, matrix algebra, Laplace transform, and other needed topics is given a brief, lucid review exhibiting the application to aëroelasticity. There are a few worked-out examples and no problems. The text is referenced to an extensive bibliography of the basic literature.

The book is based on notes developed during several years of teaching at the California Institute of Technology and is the latest addition to the Galcit Aëronautical Series.—JAMES B. EDSON.

Buffalo Bill: King of the Old West. By Elizabeth Jane Leonard and Julia Cody Goodman. New York: Library Publishers. 320 pp. $4.95.

WILLIAM F. CODY, better known as Buffalo Bill, wrote many books covering his life as Indian fighter, Pony Express rider, Army scout and guide, and master showman. However it remained for Dr. Leonard, author and editor of numerous books on the American West, in collaboration with Julia Cody Goodman, oldest

FACTS

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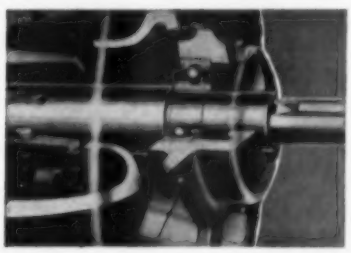

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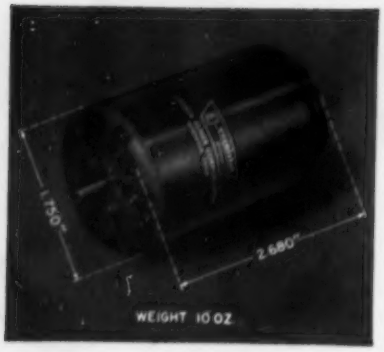

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- **high linearity,** inherent in the design principle, is *maintained* over the life of the unit.
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- **high output current capability.**
- **low phase shift** – less than 90 seconds, depending on model.
- **can be coupled with synchros,** resolvers and other components – as well as ganged.
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Output Impedance..less than 130 ohms

Input Voltage..... 130 v max.

Input Impedance....up to 75,000 ohms

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PERKIN-ELMER CORPORATION

Norwalk, Connecticut

Book Reviews

sister of Buffalo Bill, his favorite and confidante, to produce this authentic biography almost three decades after Buffalo Bill's death.

His life is legendary and more or less well known. His sentimental and religious side is less familiar. This volume brings together the reminiscences of his sister together with many unpublished letters and memorabilia.

The book is annotated, contains a genealogy of the Cody and Frederici family, an excellent bibliography, an index, and numerous illustrations. It is recommended reading for twentieth-century armchair pioneers.—THOMAS K. VINCENT.

The New Warfare. By Brig. C. N. Barclay. New York: Philosophical Library. 65 pp. $2.75.

"THE new warfare" is here defined to include Russia's post-World War II methods of limited hostility: psychological warfare, underground activities, armed threats, and peripheral warfare by proxy. The author expresses the view that this modern substitute for all-out conflict will continue for many years and therefore must be better recognized and analyzed by the Western democracies.

The theme is introduced by a brief but interesting evolutionary background on the scope and cost of "conventional" warfare beginning in 1066 with the Battle of Hastings. We find the Normans and Saxons at this battle with less than 9,000 men each. The numbers grew by slow increments until the new phase of history began with Napoleon's invasion of Russia with an initial strength of 350,000 men.

Despite the increase in the size of the armies, wars remained localized until 1914 when they became ruinous to the entire international economy and on a scale beyond man's means. This is the background from which we view events today, and the author contends that, with the world economy so strained, the "new warfare" is the limit which the nations can wage without disaster.—JOHN J. DRISCOLL.

BOOKS RECEIVED

The American Story. By Garet Garrett. Chicago: Henry Regnery Company. 401 pp. $5.

Armes Anciennes. Edited by René Géroudet. Published in French twice a year at Geneva, Switzerland. 32 pp. Yearly subscription, $2. This is a semiannual review devoted to arms and armor from the Middle Ages to the eighteenth century, published with the collaboration of European military historians and arms experts.

The Art of Knotting and Splicing. By Cyrus Lawrence Day. Annapolis, Md.: U. S. Naval Institute. 240 pp. $5.

Atoms for Peace. By David O. Woodbury. New York: Dodd, Mead & Company. 259 pp. $3.50.

Brassey's Annual. The Armed Forces Year Book, 1955. Edited by Rear Adm. H. G. Thursfield. New York: The MacMillan Company. 460 pp. $9.50.

Celestial Navigation for Yachtsmen. 3rd Edition. By Mary Blewitt. New York: Philosophical Library. 64 pp. $2.75.

Christopher Columbus, Mariner. By Samuel Eliot Morison. Boston: Little, Brown & Company. 224 pp. $3.75.

Commando Extraordinary. By Charles Foley. New York: G. P. Putnam's Sons. 241 pp. $3.75.

The Dam Busters. By Paul Brickhill. New York: Ballantine Books. 185 pp. $2.

The Desert and the Stars: A Biography of Lawrence of Arabia. By Flora Armitage. New York: Henry Holt & Company. 318 pp. $4.

Dictionary of New Words. By Eric Partridge. New York: Philosophical Library. 234 pp. $6.

Effects of Carbon, Oxygen, and Nitrogen on the Mechanical Properties of Titanium and Titanium Alloys. By H. R. Ogden and R. I. Jaffee. Columbus, Ohio: Titanium Metallurgical Laboratory, Battelle Memorial Institute. 100 pp.

Fragebogen (The Questionnaire). By Ernst Von Solomon. New York: Doubleday and Company. 525 pp. $6.

Guns and Hunting. By Pete Brown. New York: A. S. Barnes & Company. 224 pp. $1.95.

Laughter in Hell. By Stephen Marek. Caldwell, Idaho: Caxton Printers, Ltd. 256 pp. $5.

Lawrence of Arabia. By Richard Aldington. Chicago: Henry Regnery Company. 448 pp. $5.

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The Sea Wolves. The Story of German U-Boats at War. By Wolfgang Frank. Translated by Lieut. Comdr. R. O. B. Long, R.M.V.R. Foreword by Vice Adm. Leland P. Lovette, U.S.N. (Ret.). New York: Rinehart & Company. 340 pp. $5.

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U. S. Military Doctrine. By Brig. Gen. Dale O. Smith, U.S.A.F. Boston: Little, Brown & Company. 256 pp. $3.50.

HELICOPTER INSTRUMENTS AND CONTROLS DEMAND SPECIAL DEVELOPMENT

... they've been getting it at Sperry's Flight Research Center, MacArthur Field

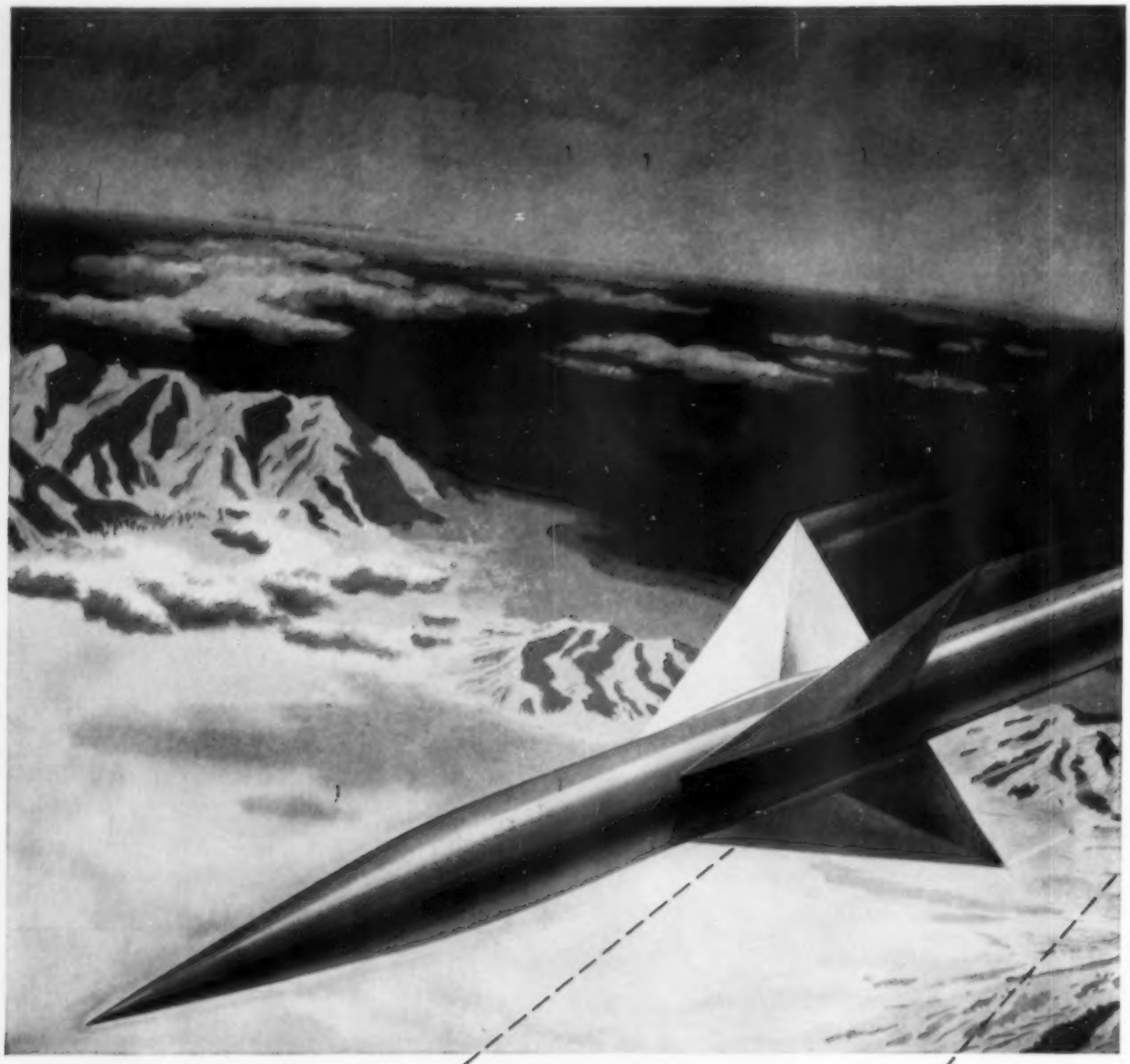
■ One aircraft of the fleet in Sperry's flight research program is the Sikorsky S-55 you see above. This flying laboratory is completely equipped with the latest in helicopter instruments and controls. It is flown by Sperry test pilots, and its crew consists of Sperry engineers who note and record the performance of the instruments and controls under all flying conditions.

■ As a result of over 10 years' constant flight research in this field, Sperry has now perfected a new flight control system which gives precise automatic stabilization and control of helicopters even under the most exacting condition of hovering. In addition to providing precise control, a new automatic stabilization system relieves the pilot of constant, fatiguing manual manipulations.

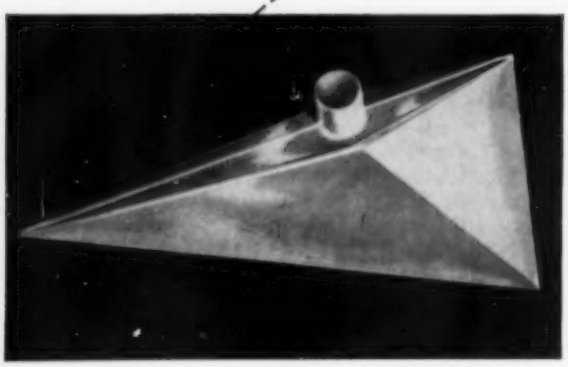
■ A helicopter integrated instrument system including a flight director has been developed—and, also, a new engine rpm control.

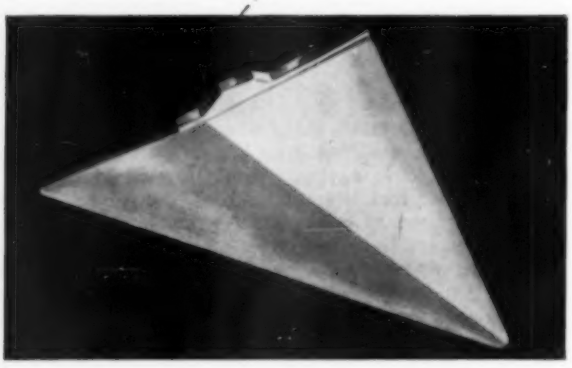
■ Write our Aeronautical Equipment Division concerning your helicopter instrumentation and control requirements.

SPERRY GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION



How much machining did these





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THE FINS on this air-to-air guided missile—the Sparrow—are Kaiser Aluminum die forgings, which provide maximum strength with minimum weight.

They must be accurate enough to maintain the missiles' true course.

You might guess that considerable machining of the fin surfaces would be necessary. Actually *no* machining was done—none was necessary.

Extremely complicated parts can be forged by Kaiser Aluminum to close tolerances, and with a finish so satisfactory that costly finishing is unnecessary.

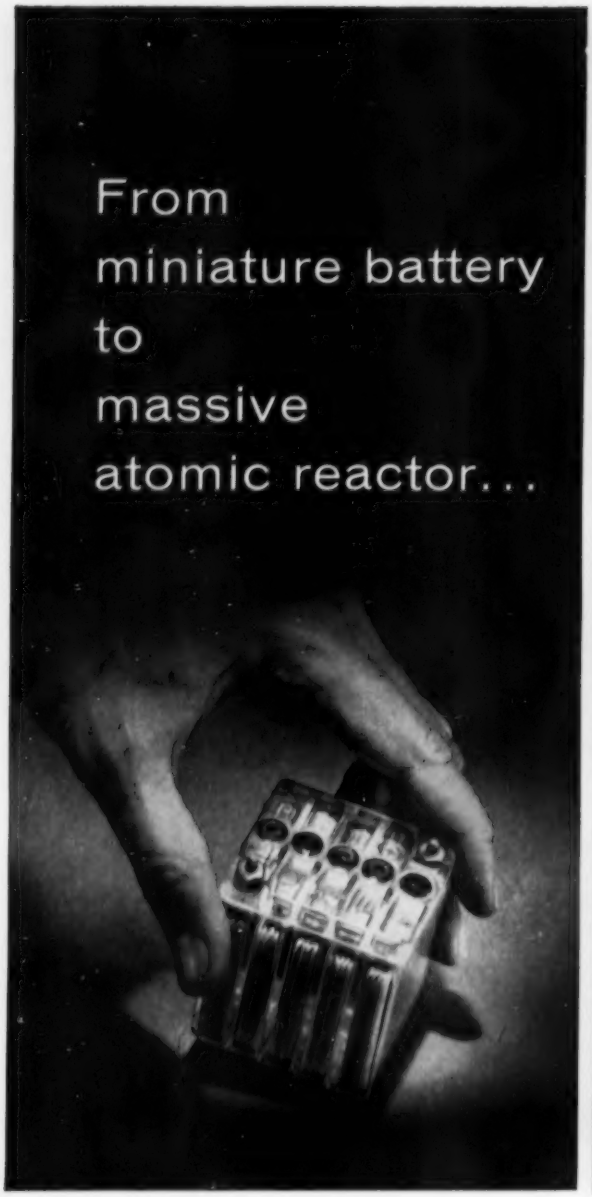
If *you* have a part that must be light, corrosion-resistant and strong, think of Kaiser Aluminum forgings.

A Kaiser Aluminum engineer will be glad to help you at no obligation.

For complete information, contact any Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc. *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum

setting the pace—in growth, quality and service



Storing electrical power in small packages, or helping to make atomic power practical . . . each demands advanced technology. And these are but two of the *hundreds* of complex tasks the AMF organization performs every day.

The highly specialized yet widely diversified activities of some 35 engineering and production facilities provide AMF with a wealth of experience that covers nearly every field of industry. And it is immediately available to *you*.

Call upon AMF with your problem. See for yourself why this all-around experience in answering the needs of government and industry alike has made AMF the "can do" company.

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AMERICAN MACHINE & FOUNDRY COMPANY, Defense Products Group, 1101 N. Royal Street, Alexandria, Virginia
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All over the world, technical "Minute Men" of the RCA Service Company assist the U. S. Army, Navy, Air Force.

How RCA "Minute Men" give added strength to our Armed Forces everywhere

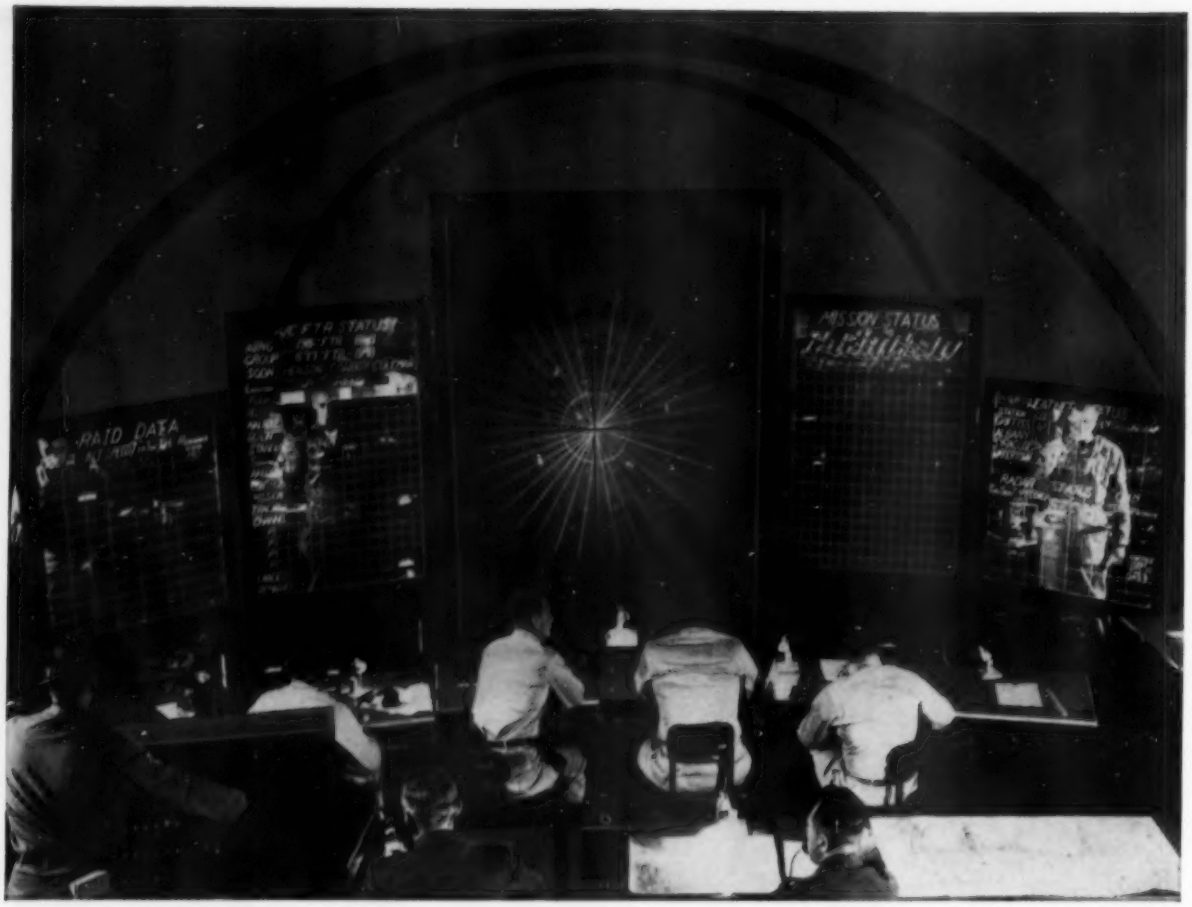
At an Army camp in Northern Japan, RCA engineers check an outlying radar post. At an Air Force base in Florida, RCA specialists track a guided missile in flight. And at a Naval communication center in Guam, RCA technicians hurry to install a transmitter. All over the world, the technical "Minute Men" of the RCA Government Service Department are assisting our Armed Forces.

These "Minute Men"—experts in electronic installation, maintenance, and training—are backed by the RCA organization that provides the most complete electronic services and systems to the nation. Behind them stand RCA's 37 years of experience in communications and electronics; more than 70,000 RCA employees in manufacturing plants stretching from coast to coast; plus the fullest research facilities devoted to electronics that industry has ever known.

In all these ways, the RCA Government Service Department has proved its ability to give added strength to our Armed Forces in every part of the world.

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING



Official U.S. Air Force Photograph

Friend or foe? Tactical defense officers in MINK control center watch movements of aircraft as reported from radar warning sites. This is equipment developed under the direction of Rome Air Development Center.

ROME AIR DEVELOPMENT CENTER PROVIDES AIR DEFENSE EQUIPMENT FOR OUR AIR FORCE

One development agency for the Air Force's ground-based electronic equipment is Rome Air Development Center, located at Griffiss AFB in Rome, N. Y. One of the ten centers of the Air Research and Development Command, RADC is concerned with the air defense of our nation, with providing equipment for tactical supremacy, and with developing ground complexes for various navigation systems to aid all aircraft. In addition, RADC is charged with data handling improvements for the Air Force intelligence mission.

RADC is the responsible center for development, through its various contractors, of such end products as radar sites, including improved tubes, circuits, antennae, and shelters; ground communications equipment and associated support items; IFF (Identification Friend or Foe) environments, and electronic countermeasures.

Bringing complex systems from the written requirements to the actual hardware items to be used in the various Air Force commands is a long and tedious business which draws upon the skills of RADC's 500 civilian and military engineers and their many counterparts in private industry.

84

FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION

31-10 Thomson Ave., Long Island City 1, N. Y.

This is one of a series of ads on the technical activities of the Department of Defense.

Engineers at Ford Instrument Company working on a special Air Force project in one of the company's laboratories.

Better bladework with no clutchwork

HUBER-WARCO eliminated the need for a clutch when they specified an Allison TORQMATIC DRIVE in their new 5D-190—"the world's most powerful motor grader."

That means one less control for the operator—means he can concentrate on his bladework, make faster passes and smoother cuts.

The Allison TORQMATIC Converter-Transmission team in this Huber-Warco grader also reduces operator fatigue by permitting quick-shifts at full throttle with finger-tip hydraulic control—the same proved team that has seen millions of hours of service around the world.

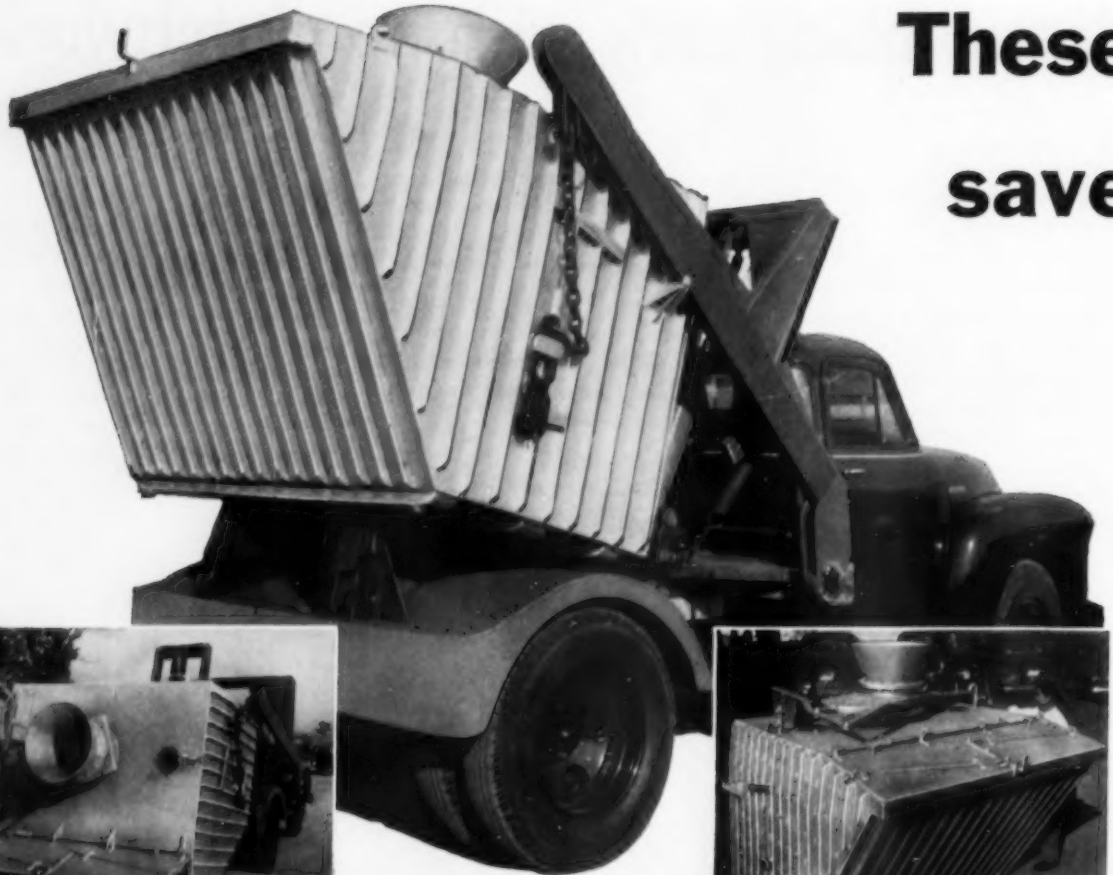
It gives a full range of working speeds—from .85 to 20 m.p.h. automatically maintained—with only three forward gearshifts instead of the usual eight.

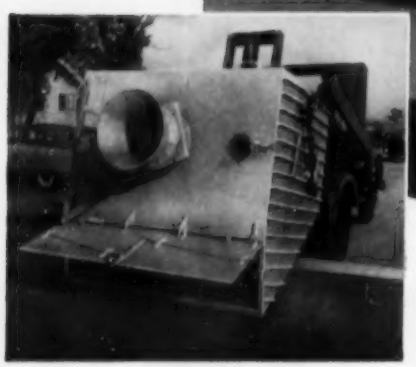
And it lengthens the life of all grader components because the TORQMATIC Converter absorbs harmful shock loads—boosts engine life by preventing engine lugging or stalling.

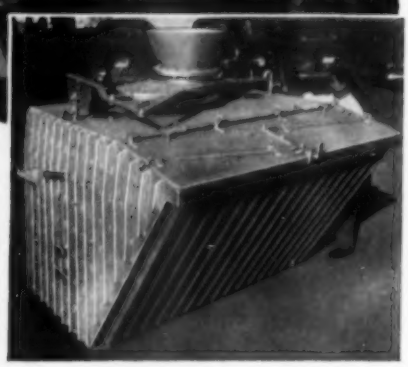
Leading equipment manufacturers have found that Allison TORQMATIC DRIVES help them build a better, faster-selling product. And their customers report TORQMATIC-equipped units do more work, faster, at less cost.

You can get Allison TORQMATIC Converters for both gasoline or Diesel engines from 40 to 400 horsepower—TORQMATIC Transmissions for applications up to 300 horsepower. Get full details on Allison TORQMATIC DRIVES for the equipment you buy or build by writing Allison Division of General Motors, Box 894W, Indianapolis 6, Indiana.

These save



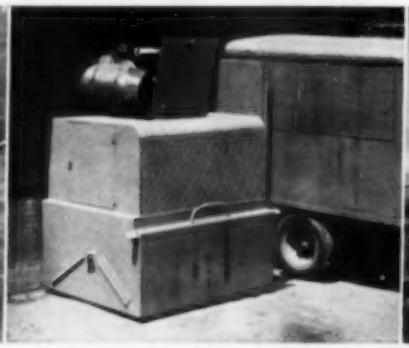




Dempster-Dumpster serving a 6 cu. yd. container with cooling fins for handling a high temperature product.

Here are a few of the hundreds of Detachable Containers we have built to solve handling problems of every description. A few others not shown include those with compartments . . . with insert containers . . . fully-insulated . . . lined with lead . . . lined with fire brick . . . with windows and doors . . . with casters . . . flat bottoms and open at one end . . . with teeth . . . with shelves for tools and supplies—and we could describe hundreds more, all served by one Dempster-Dumpster and only one man, the driver.

This 3 cu. yd. Container has skids for fork lift truck transfer.



10 cu. yd. Container widely used for refuse and combustible wastes.

Flanged wheel equipped containers for remote loading.

5176

DEMPSTER

4 manufacturers to $82,000.00 annually handling waste materials!

These four industrial plants expect to save, in labor costs alone, during the first five years service of the Dempster-Dumpster System—

A PLASTICS PLANT: $26,958.00 savings on an investment of $9,523.50 in Dempster-Dumpster equipment. Savings alone pay for equipment in two years.

A CHEMICAL PLANT: $204,076.75 savings on an investment of $40,968.00 in this equipment . . . savings pay for equipment in one year.

AN AUTOMOTIVE PLANT: $135,000.00 savings on an investment of $19,272.00 . . . savings pay for equipment in 9 months.

A PAPER AND PULP MILL: $43,104.00 savings on an investment of $10,750.00 . . . savings pay for equipment in 1¼ years.

Those are typical examples. Visualize a Dempster-Dumpster, operated by only one man, the driver, serving scores of big steel containers, one after another, in your plant. Containers of many designs and types, handling waste or salvable materials, raw or finished products, fluids including acids, combustibles, dusty materials—anything that can be handled in up to 21 cu. yd. detachable Dempster-Dumpster Containers . . . payloads up to 19 tons. Savings are tremendous! Take advantage of our free engineering service, which determines by fact-finding survey the cost cutting possibilities of this system in your plant. Dempster Brothers, Inc.

600 Gal. stainclad tank with brine cooling channels.

A Container available up to 10 cu. yds. with or without lids for many uses.

A 9 cu. yd. container for handling packaged products.

BROTHERS 916 Shea Building, Knoxville 17, Tennessee

These men help to make TV advertising more acceptable

The men are television technicians, doubling in brass as an optical expert, a photographer, and a machinist.

They solved a tough problem that faces all television broadcasters. Thanks to their ingenuity, a lot of viewers probably enjoy their TV more, without knowing why.

The American TV system is based on advertising sponsorship. Programs are sprinkled with a husky lot of commercial slides telling the story of products from A to Z.

There's the rub. Slides ought to be just as clear and non-glaring and undistorted and easy to look at as the program material itself. But artwork for reproduction is often all over the lot—some light, some dark, some on shiny paper, some on dull. Put on the air "as is," it can be pretty unsatisfactory. We wanted something better for the million-odd people in the area served by our station, WHAM-TV.

Enter some typical Stromberg-Carlson ingenuity. Three of our boys got to playing around with a machinist's milling vise, a 35mm amateur camera, and some polarized lights and filters. The result is the photo-copying device at which the men above are looking. It makes up for art deficiencies, and is so constant in exposure that a dozen different operators will produce slides of exact quality. It even has some tricky handles and wheels which enable us to create animation with still pictures!

This solution is typical of Stromberg-Carlson's challenge—"What do you mean, it can't be done?" If you have at hand a puzzle in Electronics or Communications, for *any* purpose, we'd like to tackle it.

"There's nothing finer than a Stromberg-Carlson"

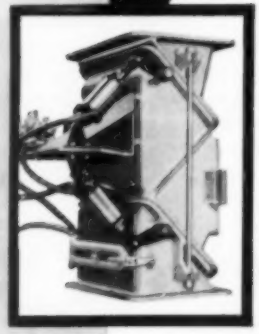
STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

ROCHESTER 3, N. Y.

Radio, TV and Hi-Fi Equipment • Telephones and Central Office XY® Dial Equipment • Sound and Public Address Systems • Electronic Products for Our Armed Forces

clearing new hurdles



The two obvious dangers in moving high explosives are large concentrations and shearing friction. Hoffman went to work to design a material handling system for ordnance depots that would clear both hurdles at once. Their answer—the ingenious double-damper valve. Safe? Yes, the valve "meters" the explosive into a Hoffman-designed pneumatic conveying system in small, spaced-out quantities. Large concentrations are avoided . . . the valve's live rubber seats eliminate shear.

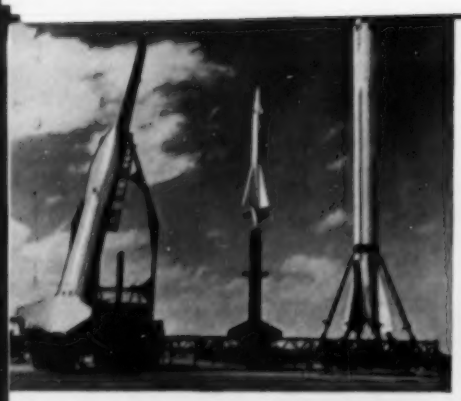
Speedy? Yes, the valve enables explosives like TNT and smokeless powder to be conveyed 500 feet in 11 seconds flat. One installation automatically transfers 200 pounds of explosive per minute, in 50-pound increments, all by remote control! Even larger systems, already developed, are capable of moving ½ ton of explosives per minute. In all cases, it is unnecessary to have large concentrations at operating locations. Additional lots of explosive are instantly available, as needed, at the push of a button—by Hoffman design.

Here is one example of the many technical hurdles that Hoffman engineers have taken in their stride. Perhaps you are seeking higher standards of safety, or a higher output in *your* operations. Hoffman imagination and engineering resourcefulness can achieve them for you. Without obligation, learn how we are prepared to make your problems our responsibility.

ORDNANCE EQUIPMENT DIVISION

U.S.HOFFMAN MACHINERY CORPORATION

Dept. Ord., 105 FOURTH AVENUE, NEW YORK 3, N. Y.



Honeywell Transistors pack "man-size" power into a "mite-size" package

for Honeywell
Customized Weapons Systems...

THE TINY Honeywell power transistors you see here at a production line test station are opening exciting new possibilities in the design of advanced weapons systems.

Developed and produced by Honeywell, these are some of the few transistors available today that will trip relays and drive motors.

They will make systems lighter, smaller and tougher than ever before—will allow them to operate on a fraction of the power they now require.

With our own transistor facilities, Honeywell Ordnance Division is in a unique position to utilize transistors in developing Customized Weapons Systems.

We are ready now to bring all of the advantages of the transistor to tomorrow's weapons systems.

For complete information on Honeywell weapon systems, write to Honeywell, Dept. OR-1-09, Minneapolis 8, Minnesota.

Honeywell Customized Weapons Systems

Turret Controls • Stabilized Platforms • Firing and Arming Systems • Navigation Systems • Meteorological Systems • Coding Systems • Munitions • Missile Components • Proximity and Mechanical Fuzes

MINNEAPOLIS
Honeywell

Ordnance Division

ARMAMENT TECHNOLOGY

This section of ORDNANCE contains selected papers presented at meetings of Technical Divisions and Committees of the American Ordnance Association and contemporary articles on armament research, development, manufacture, and field use

Military Electronics

Complex weapons systems must be designed for ease of maintenance

Lieut. Col. Leonard M. Orman

Ordnance Corps, Aberdeen Proving Ground, Md.

RECENT surveys in widely separated areas are turning up some alarming figures about percentages of electronic equipment in working order—and these are peacetime figures. When we apply the combat deterioration factor, which has been estimated to be 3.65, we approach a low figure indeed.

What is the answer? Can we do with less electronics? Few of us think this is possible. The complexity of today's military problems demands the assistance of the electronic art.

MUCH use is being made by all of the armed forces of contractor's field engineers. One company flies an airplane to Air Force bases, picks up electronic equipment for higher-echelon maintenance, and returns it to the factory. The suggestion has been made that these facilities could be expanded. The magnitude of the wartime problem and the constant shortage of engineers and highly skilled technicians in industry would seem to preclude serious consideration of this possibility.

The fact that the largest percentage of our Army today and for the foreseeable future consists of soldiers whose tour of duty is limited to two years, makes the field-maintenance problem all the more difficult. The usual maintenance course today is nine months long. When this is added to the normal three months of basic training, pipeline, and leave time, it can be seen that the maintenance man does not have many months of service left. We all know how green most graduates of any school are. The high level of skill developed only through long practical field application of classroom theory is not being developed today.

HOWEVER, we can expect the use of electronics to continue to increase—and with it the maintenance problem. We cannot look to industry to furnish us enough field engineers to solve the problem. Faced with the draft as the main source of manpower, we cannot expect any great change in the caliber of our maintenance personnel.

It would seem then that the onus of the solution to this difficult problem lies squarely upon the shoulders of the technical services and the manufacturers. Every possible avenue which might lead the way to more reliable equipment, easier to maintain in the field, should be vigorously pursued.

Military characteristics (MC's) are nothing more than educated engineer-

CONTENTS

ARMAMENT TECHNOLOGY SECTION

Military Electronics 709
Lieut. Col. Leonard M. Orman
Complex weapons systems design

Ceramic Cutting Tools 712
P. A. G. Carbonaro
Use of sintered alumina tips

Powdered Metals in War 714
John D. Dale
A solution to some problems

Secondary Ordnance Items .. 719
Charles W. Fauroat
New computing methods

Towed Gun Carriages 723
N. S. Glassman
Such artillery has advantages

ing guesses of the needs of field forces. Every effort should be expended to meet the MC's. Oftentimes the state of the art will have to be extended to achieve them, but by this type of approach the impossible has been achieved in the past.

On the other hand it behooves the technical services to keep the field forces informed of the complexity required to obtain an object. A battery commander would certainly prefer a radar which would stay on the air ninety per cent of the time to one which was down fifty per cent, even though the first one didn't have quite all the gadgets of the second.

ONE recent project designed as a result of MC's proposed a solution which had 4,000 vacuum tubes. This was to replace a device which presently has 120 vacuum tubes. The manufacturer had made a sincere effort to achieve everything that the MC's called for but in doing so he created a monster that the user wanted no part of. Closer liaison during the progress of the project would have prevented this.

In this project seventy-five per cent of the equipment was required to achieve the secondary purpose while only twenty-five per cent was required to attain the primary requirement. The user was quick to drop the secondary requirement when apprised of the result.

Since the beginning of World War II a generation of electronics engineers has grown up in the industry who can solve almost any problem with an appropriate circuit. However, in their haste to achieve a solution to a problem it appears that they perhaps take the most obvious solution. We have never asked the design engineer to give us the most simple—the most reliable circuit. We have not asked him to design equipment for ease of maintenance.

SHEER necessity has forced some progress in the maintenance field. In some equipments we now have slide-out drawers with swinging panels to allow easy access to tubes, tube sockets, and other components. We do have interchangeable components and easily replaceable chassis. However, in others we follow ancient tried-and-tested designs which require removal of a large number of screws before the panel will even permit a look at the works of a set.

"The fact that the largest percentage of our Army today . . . consists of soldiers whose tour of duty is limited to two years makes the field-maintenance problem difficult . . . The high level of skill developed only through long practical field application of classroom theory is not being developed today."

In some countries of Europe the level of education of the average soldier makes the maintenance problem in the field even tougher than it is in our country. For this reason the designers of electronic equipment seem to be doing more to make trouble shooting easier. An antiaircraft electronic computer which I inspected in Europe had all test points brought out to the front of the set. Through probes in these points a repairman should quickly be able to isolate most troubles into one of the eight drawers. When the proper drawer was opened, neon lights would indicate the faulty unit. The unit, which consisted of about three tubes and a few related condensers and resistors, could be unplugged. A spare unit was available in an adjacent slot in the same drawer. It certainly wouldn't take nine months to train a man to trouble-shoot that kind of equipment.

A BRITISH study of a fire-control radar concluded that seventy-eight per cent of the tubes could be metered either directly or indirectly, which would be invaluable in analyzing faults.

A word of caution must be introduced here. We must not lose proper perspective in our objectives. Reliability precedes maintainability. To bring test points to the front of the set, to incorporate neon lights, and to meter the maximum number of tubes all require extra wires. We don't want to strangle ourselves in our own wires!

The conventional approach in the design of electronic equipment and placement of it in a van seems to be to leave concern about heating and cooling until after the equipment is installed. From an examination of many modern sets it would appear that the designers had never given heating and cooling a thought. Electronic equipments generate heat, and overheating is one of the enemies of electronic equipment. Placement of vents in proper places in vans and chassis could simplify both the cooling and heating problems.

Are we going overboard for electronics? Take computers for example. Perhaps with the trend to Eniacs, Ordvacs, and Edvacs we have concluded that all computers should be electronic. The argument seems to be that electronic solutions are faster, and in these days of fast-traveling targets we need the fastest possible solution. A European engineer countered arguments along these lines with the following reasoning:

"WITH the simple antiaircraft problem the greatest time involved is in the input of the data into the computer and the extraction of the solution. The actual solution of the problem occupies only a small portion of the total elapsed time. The input and extraction processes are practically the same whether dealing with electronic or mechanical computers. Since mechanical computers are easier to maintain we prefer them for antiaircraft computers."

Maybe he has something there.

A reëxamination of circuits in a modern fire-control system revealed that twenty-seven tubes, almost ten per cent of the total in the entire system, could be eliminated by substituting mechanical drives. Those twenty-seven tubes will never burn out at a crucial moment in combat. There is a lot of merit in mechanical solutions to some of our requirements. Certainly from a maintenance viewpoint there is a lot to recommend mechanical devices.

ONE popular concept forced on the user by the technical services and by joint service planners has resulted in additional complexity of sets; namely, that it is economical to design a radar to do a multitude of jobs and that a radar designed for one service should be applicable to another. Sometimes this reasoning is fallacious.

I have a specific example in mind of a radar set which is trying to do two jobs. As a result, performance is a compromise. It does neither job as well as it might if it were designed to do only one. It has more complexity than would

be required for a single job, hence more off-the-air time.

Another set designed for the Marines was adopted by the Army. At first this appeared to be an excellent idea. However, it was later found that the Marines' requirement for portability necessitated more cabling than the Army required. By shortening the cables, $1,000 per set was saved.

WHEN it is realized that the Army purchased over 1,000 of these sets, the savings were considerable. Shorter cables means less line losses also. Had the set been designed for Army needs alone, further savings probably could have been effected.

A recent article in the *Proceedings of the Institute of Radio Engineers* discusses some aspects of this problem in an article entitled, "Is Complexity of Military Electronics Necessary?" The author's principal thesis is that we must have these equipments and that some of them will undoubtedly be complex. However, he avers that few instruments are as complex while at the same time possessing a high degree of reliability as the modern dial telephone switching equipment.

Indeed, none of us consider this equipment and all of its adjuncts as highly complex gear. This has been achieved in part by the systems concept of design. Recently, we have adopted this approach ourselves. We no longer design a radar and a computer separately and hope that they'll work together as the SCR-584 and M-9 fortunately did. But I'll let you read the author's conclusions for yourself:

"Modern military equipment, to achieve the most precise solution to dynamic problems, must rely on complex instrumentation to permit optimum use of the human being. To the user, complexity of itself is of no real significance except as it affects reliability. . . . The 'systems' concept in engineering administration and technical control is essential to ensure success in achieving reliability.

"Systems engineering is the new frontier in the engineering profession. Our goal must be to achieve reliability in spite of complexity."

ANOTHER recent guest editorial in the same publication criticizes military electronic equipment from another viewpoint. His article, which was entitled "Electronic Design for the Military," claims that the services are using techniques abandoned by industry twenty years ago. It says, in part:

"A lack of symmetry and maze of wires in commercial designs does not mean quality has been sacrificed. The primary requisite of commercial designs for mass production, such as radio and TV sets, is that they must have highest reliability. No reputable manufacturer sacrifices reliability for price consideration, nor could a manufacturer who did so remain in such a highly competitive market.

"For example, the use of component mounting boards, screw machine soldering terminals, and cabled wiring were abandoned by radio industry for commercial receivers in the middle 'thirties; we still find these the rule rather than the exception in present-day military equipment . . ."

He deplores the breaking up of design into units and the use of plugs and sockets for interconnections. This trend is particularly unfortunate when applied to weapons where reliability is of utmost importance. Radio industry abhors plugs and cables with friction contacts, short leakage paths, and increased circuit intercoupling.

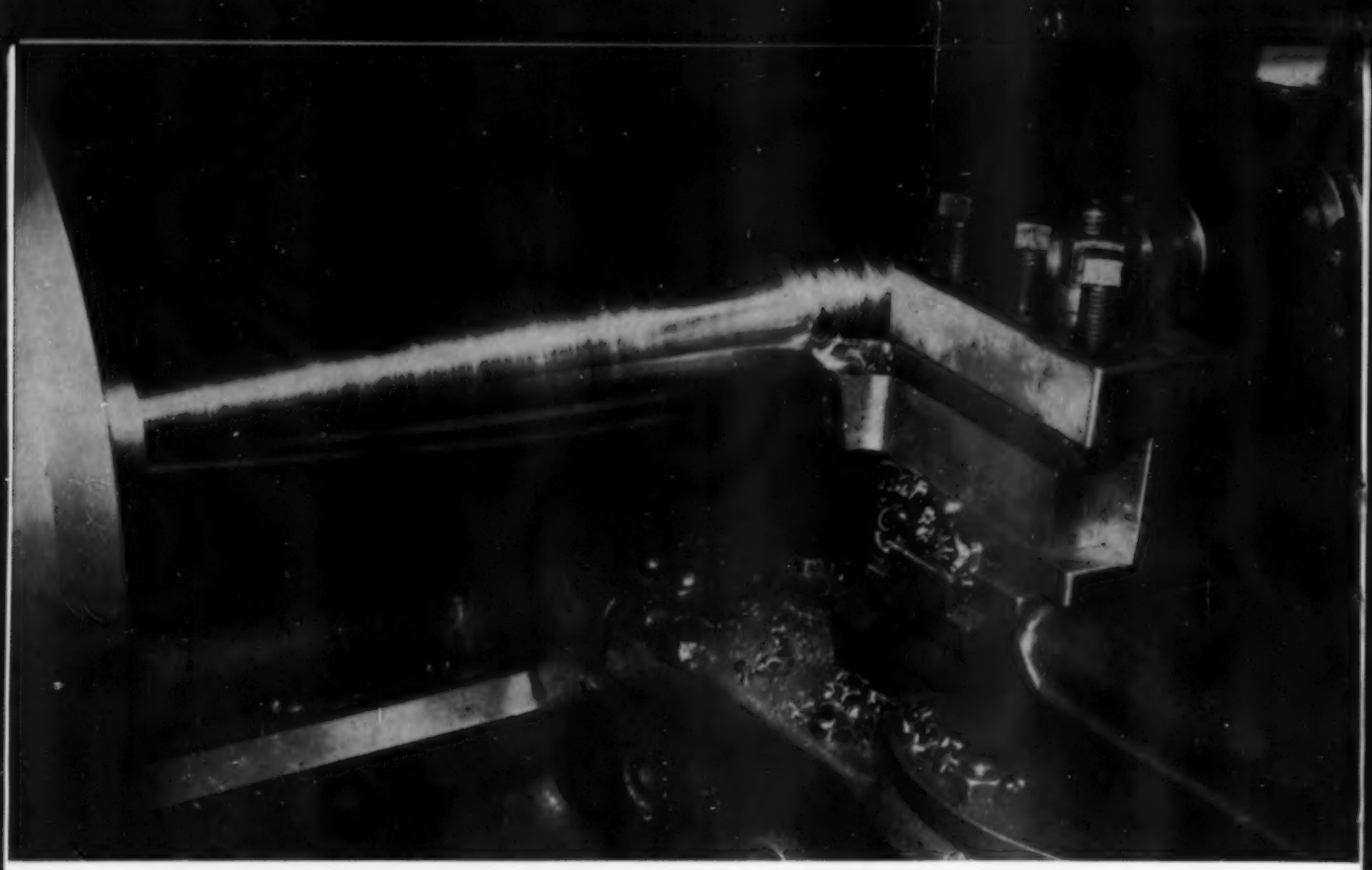
The author maintains that cardinal design principles demand soldered connections, point-to-point wiring, and layout for accessibility so that all joints may be inspected.

Technicians at the Bell Telephone Laboratories set up a simulated firing course on electronic equipment built to study the action of the Nike guided missile.

WHILE I'm not certain that all these criticisms are justified, we cannot afford to ignore them. We should subject ourselves to a severe soul-searching to see if departures from accepted commercial procedure are warranted.

So little attention seems to have been given to this problem that manufacturers have been accused of being uninterested. "After all," it has been said, "why should they be interested in designing a simple device—they work on a cost-plus basis." No one who works with our major companies today believes that they have such an approach.

I recently reëncountered an engineer with whom I had gone to school. He told me that he was working on the design of a project with which I was connected and asked my advice for guidance. My reply might well serve as the summary for this article: "Just keep it simple, please."



Ceramic Cutting Tools

Sintered alumina tips can replace strategic tungsten-carbide implements

P. A. G. Carbonaro

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DEVELOPMENT of ceramic tools for metal-cutting purposes has been actively under way at the General Rodman Laboratory, Watertown Arsenal, Watertown, Mass., since the founding of the laboratory early in 1954. It has been long recognized that substitution of strategic elements commonly employed for metal-cutting tools with nonstrategic materials would alleviate industrial hardships encountered especially during emergency periods.

The inability to obtain requisite supplies of tungsten-carbide content and high-tungsten-alloyed tool steels during World War II and the Korean conflict demonstrates forcefully the advantages derivable with the utilization of cutting-tool materials composed of nonstrategic elements. It was felt that ceramic materials might provide the answer to this pressing problem.

A review of available foreign and domestic literature on the subject, a study of mechanical properties of potential possible nonstrategic materials, and consideration as to the availability of the basic material comprised the initial steps of the program. Because of its ability to retain strength at elevated temperatures, its attainable hardness level, and its wear resistance, sintered alumina offered considerable promise toward the solution of the problem.

Alumina is readily available in abundant quantities within the continental limits of the United States and is nonstrategic in character. With proper processing, high-quality sintered alumina (over 99 per cent Al_2O_3) is capable of developing high densities (3.9) and high hardness (90 Rockwell "A").

A PROGRAM, rather broad in scope, was established to investigate sintered alumina with the early phase encompassing a critical review of the ob-

tainable information and exploratory evaluation studies on readily available aluminum oxide base ceramic materials.

Some of the alumina-base materials were available only in extremely small batch quantities, and it was felt at the start of the program, that with the attainment of satisfactory results, establishment of procedures to supply the desired type of material in large quantities would follow a normal development course.

NUMEROUS samples were procured from academic and commercial sources, while other samples were produced at the Rodman Laboratory from conventional laboratory equipment normally utilized for the production of ferrous materials.

A clamp-on-type tool holder was designed to utilize advantageously the desirable properties of the material while simultaneously minimizing the undesirable characteristics inherent in ceramic materials known to date. A tool holder considered to be of "ideal" design for the purpose is shown on this page. The design offers maximum tool support, orients cutting stresses in such a manner so that the tool stresses are essentially in compression during the cutting operation, and incorporates other features such as an infinitely adjustable chip breaker and hardened face plate to relieve tool erosion.

Due primarily to size limitation of available ceramic materials, less elaborate tool holders have been utilized with considerable success, indicating possible development of simplified holders. Brazing of the ceramic tip onto the steel shank is feasible and has been discussed in the literature.

Tool geometry was evolved after limited study and trials during this phase of the program and has given satisfactory results to date. The studies are continuing to evaluate other possible tool geometries for specific uses.

Tool-grinding techniques utilized in the program are parallel to techniques employed in the preparation of tungsten-carbide tools, except that in the preparation of ceramic material the time required for shaping the tool is considerably less than the time required for shaping tungsten-carbide cutting tips. It was felt more desirable, for instance, to utilize diamond-grit wheels for finish-grinding and honing.

Numerous grades of ferrous and nonferrous metallic materials have been machined experimentally without coolants with the ceramic tool developed, utilizing a standard 18-inch lathe. The workpieces were rotated at various feeds and speeds to determine the limits of the application.

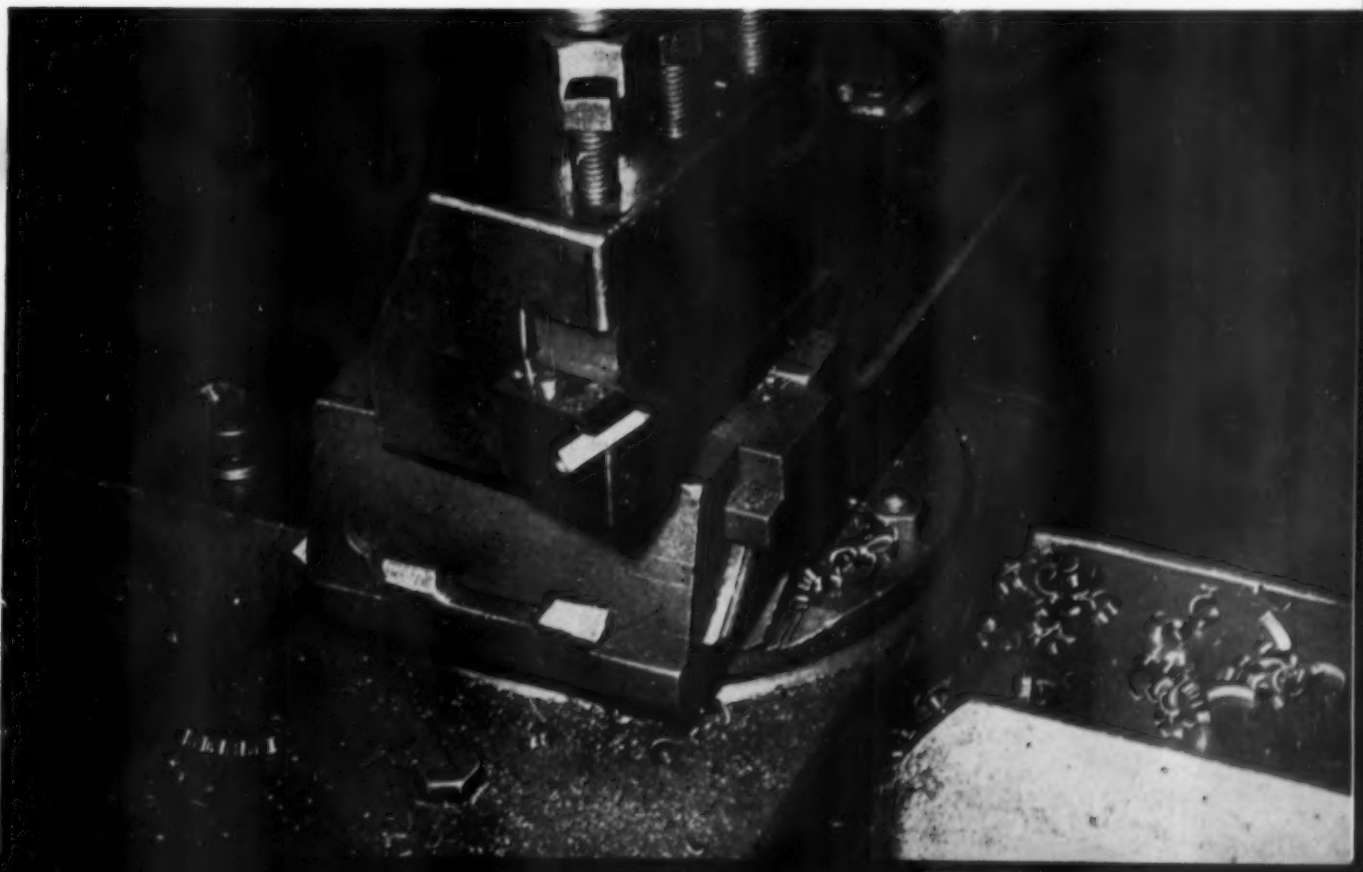
The limiting factor to date has been the machine tool rather than the cutting tool. The limitations of the tool have not as yet been completely determined, and such studies are continuing at an accelerated pace.

THE illustration on page 712 shows the lathe setup utilized during experimental machining of an artillery shell. Surface speeds as high as 1,560 feet a minute were utilized in some operations, but it was determined that at the higher speeds a coolant would be necessary, since the heat generated caused melting of the chip.

Results under the program have been promising. Exceptionally high cutting speeds have been attained with sintered alumina cutting tips. The material is more resistant to abrasion than other materials available for cutting purposes. In addition, results have indicated the need for machine tools operating at higher speeds.

The material is readily obtainable, but requires close control during processing into the end item. Basic material cost of a ceramic is from one-third to two-thirds that of low-quality steel.

A sintered alumina cutting tip is shown clamped into place in a tool holder ready to be used in cutting operations.



Powdered Metals in War

Proper application and use of metal powder in the manufacture of production parts can help solve problems of materials, labor, and skilled know-how with increased quality and a reduction in costs

John D. Dale

DURING the Korean war it was the stated policy of the United States Government that a "guns-and-butter" economy would prevail. While war matériel had to be produced in support of our obligations to the United Nations in Korea, the meeting of these obligations was to be done with the least possible dislocation to the American civilian economy and the least cutback in the production of consumer goods.

As a political objective, the Administration wanted to ensure that we could not be accused of waging a war in Korea. It was called a "police action" supported by a mere segment of our productive resources. Another political objective was to demonstrate to the entire world the strength of the American economy as well as the determination of free Americans to preserve the peace. If by bad luck the "action" were to have spread, then the strong civilian economy could have been wholly converted to military production as it was in World War II.

THERE is every reason to believe that the economic planners in Washington also saw an opportunity to further their goals of full employment, higher consumer spending power, and the management of the economy. None of these objectives was found in conflict with the political objectives.

But full employment meant that mobility of labor was at a minimum. This was especially true of skilled labor.

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Skills were not readily available where they were most needed. Career engineers were not pressed into war production from their civilian positions, except those holding military Reserve commissions who were recalled to active duty.

The shortage of experienced engineers available for military research and production was critical. The same was true of experienced operating management personnel. The planners anticipated the development of material shortages, especially in copper, aluminum, and steel products. The machine-tool industry had been working in the doldrums since the end of World War II, and capacity to retool for the military production program was plainly inadequate. Thus military planning in any degree of reality was an extremely difficult task.

These age-old logistical problems were magnified and aggravated as a result of the political and economic policy objectives. Time, an irreplaceable resource, was running out. The national policy having been declared, we were fortunate to have "good soldiers" in and out of uniform, able and willing to tackle these problems.

By mid-1951, Congress had taken care of the military manpower problem by means of the draft. The first of the materials controls were legislated into being by the Controlled Materials Plan. When CMP was made effective in the Department of Defense, CMP officers were appointed throughout the military establishment and began allocating the available supplies of copper, steel, and aluminum to the arsenals and military contractors.

MACHINE-TOOL control officers were then appointed in every military installation. Civilian consultants in every field of science were called in from industry and the universities to reënforce the Government's program of materials and methods studies which were made not only to improve matériel but to anticipate conflicts or shortages. Centralized Federal control of materials and manpower did not appear to be the answer to the manufacturers' problem, and a key official of Army Ordnance at that time posed a serious question, the several answers to which were strangely complementary.

What were the solutions to the problems of materials shortages, labor shortages, and skilled manpower shortages, all of which had their impact on production delays, quality of work, cost, and ultimate performance? A few weeks after the question, this same official asked for a brief summary of the advantages and limitations of powder metallurgy as applied to ordnance.

In suggesting solutions to the major problems of supply and production, it was found that they correspond exactly to the five or six major advantages of applied powder metallurgy. Certainly not all the major problems can be solved by applying powder metallurgy in logistical problems up to the delivery of the end item of manufacture, but the principles of application at the right time and in the right place are a pattern by which other applied materials and methods have solved other major problems.

TO mention a few, die casting of nonferrous metals, cold extrusion of alloy steels, impact extrusion of aluminum, the application of new plastics, plating, and automation are outstanding examples. The fact that this question was directed to the officer in charge of the Special Projects Office at the Frankford Arsenal during the Korean war has considerable bearing on association of the several answers.

As Special Projects Officer, I was responsible for the CMP there, the allocation of machine tools for the national procurement programs under the supervision of the arsenal commander, coordination of applied powder metallurgy in Ordnance, together with a host of other somewhat unrelated projects.

When a production program sponsored by the military is actually in motion and materials become in short supply, the situation must be anticipated so far in advance that no explanation is needed by arsenal commanders or by the chiefs of the Ordnarce commands as to why a program is delayed. The goods have to be delivered on time, and it is up to the operating engineers in the military establishments to assure their timely delivery.

It may still surprise the industrialists that the Army had just as much difficulty actually getting copper and brass during the Korean emergency as any civilian establishment with a comparable CMP rating. Many a CMP Officer across the United States was frantically trying to get metal which his organization had to have, to which it was entitled by law, and yet which was physically not available in the shape or form required.

Anticipation of shortage or delay often took the form of the CMP Officer sitting up late at night or all night long with his commanding officer working out ways and means of avoiding any interruption in delivery schedules.

More than once the commanding officers of arsenals and Ordnance district offices telephoned their superiors or each other in the early hours of the morning to state the simple fact that materials were physically not available and that executive action had to be taken if delays were to be avoided. More than once procurement officers were told that copper and aluminum were available in the form of ingots or sheet whereas the desired form might have been rods or tubes.

ON the other hand, copper in the form of powder provided an extremely flexible raw material where the finished part did not demand a special size or shape of tubing, bar stock, or sheet. In powder metallurgy the scrap loss usually was eliminated completely, and within the scope of the process the supply of the raw materials was more than adequate to take care of the entire military requirements for any copper part which could have been made by the process at that time.

The powder-metallurgy process is thus known to be an answer not only to the requirement for special shapes not generaly available, but, due to scrap loss elimination, the total quantity of copper required is actually less than wrought materials. The sintered copper rotating band for 20-mm. projectiles was the classic example during World War II of powder metallurgy applied to solve an impossible situation in the supply of copper tubing of the correct size.

THE CMP legislation at first gave the arsenal commander and his superiors a distinct impression that on authorized programs they could obtain the copper, brass, steel, or aluminum which they needed simply by writing a CMP "ticket" on the producer of the raw metal. It took three months to find this was simply not the way the CMP system actually was to work.

As a critical factor in production delays on items scheduled for delivery to troops in the field, the problem was transmitted quickly by commanders through channels to the top echelons of the Department of Defense, to Congress, and to the Executive Office of the President of the United States.

In the case of 1020 steel tubing shortage, for example, no amount of command action produced the tubing. On the other hand, by applying the powder-metallurgy method to iron powder, the problem was solved locally while telephone memoranda, teletypes, and red-bordered letters surged through the

Metal filters for corrosive media can be produced successfully from sintered stainless steel powder.

halls of bureaucracy in Washington.

Officials of the Ordnance Office will recall that during World War II the sintered copper rotating bands were delivered within thirty days from the date of release of specifications, just as the steel tubing during the Korean war was available within thirty days. There was a time interval required for testing and proving the substitute material, and revised specifications had to be written. Then tools had to be manufactured.

BUT today the tools are ready, the specifications are in being, and if another emergency should arise not even four weeks' delay will be necessary for the delivery of the first units.

Specifications to cover similar substitutions are also ready for issue, having been developed since the beginning of the Korean war, and they cover a large array of metal components which may be required again by the Signal Corps, the Chemical Corps, the Ordnance Corps, and the Air Force. A typical metal product needed in enormous quantities during a national emergency is the rotating band for artillery projectiles.

The sintered iron rotating band is a good example of a military component which is not needed generally during peacetime where there is a fair supply of copper or gilding metal available. However, every war in our history has produced such a severe copper shortage that a satisfactory substitute for copper had to be found if firepower, life of weapon, and accuracy were to be maintained in our field artillery and tank guns.

The sintered iron rotating band is ready now for immediate use, backed by a capacity for producing iron powder which guarantees the country a virtually unlimited supply of metal in the form which can be applied to any size rotating band within days.

Mass production has been credited with one of the underlying reasons for American economic and military successes. Mass production is probably the only answer to the problem of getting delivery on a critical component delayed in a production program which otherwise is on schedule. By mass production is meant turning out millions of uniform pieces a day from a single plant facility. Mass production relates to time as well as quantity. To achieve mass production and gain time are obvious answers to military production problems. Both are well-demonstrated advantages of the powder-metallurgy process.

Small pinion gears with slotted hexagonal heads, gear teeth, and center holes pressed simultaneously in one operation at a cost saving of 68 cents per gear.

The time element includes both production time and tooling time. When tooling a conventional plant, conventional metalworking equipment generally is placed in line and the time required to plan and set up the line takes anywhere from ten to twenty weeks even if all the equipment is on hand. If only one machine tool is lacking, usually the entire line is held up. One operation missing in a sequence is all that is needed to prevent production.

DURING the Korean conflict there were certain special machine tools on which 72-week delivery was normal. The Korean emergency produced no exceptions to the general rule that in time of war, even on a preference-delivery basis, twenty-six to thirty weeks' delivery on relatively ordinary machine tools is normal. Highest preference, other things being equal, was generally given to a contractor requiring only one or two units to put a line in operation, as compared with a contractor who required simultaneous delivery of several machine tools.

Of course, today delivery can be made within two or three weeks on almost any standard machine tool. The Department of Defense has attempted to solve the problem of emergency delivery of major machine-tool items by developing a stockpile with its primary objective of maintaining a machine-tool production base. This may be a partial answer, but powder metallurgy goes much farther toward the solution of the machine tool availability problem, at least within the scope of its possible applications.

HYDRAULIC and mechanical presses are universal tools which in the powder-metallurgy industry are put to work on an infinite variety of mechanical parts. For the most part the dies and punches are the only special tools required and to a great extent are interchangeable from one production facility to another anywhere in the United States. It takes only two or three weeks to make a simple die and from six weeks to eight weeks for the more complicated dies.

In time of emergency the bottleneck is not the major machine tool item, it is only the time and material needed to make the specific dies for new items which have never been made before.

For standardized items the dies are on the shelves of many a contractor who has produced before and who is ready to produce again instantly. The interchangeability of dies on almost any press in the country from coast to coast and from the Canadian border to the Gulf of Mexico is a factor of strategic importance if the United States were ever attacked. Even if a producing facility were completely destroyed the tools could be duplicated elsewhere within weeks for prompt resumption of mass production.

Powder metallurgy does away with the old concept of the production line and, within its scope of application, eliminates the machine tool procurement problem. It also eliminates the recurring problem of obtaining the proper form of raw material so prevalent in conventional factories, because the raw material is a pail of powder

from which an unlimited variety of metal components can be manufactured by means of the single controllable variable—the molding die.

In time of war, costs do not usually mean very much. At least costs are secondary when lives are at stake. One thing plentiful in the United States, apparently, when it comes to national security, is money. In fact even our present peacetime policy of national preparedness has been backed up by the largest peacetime military budget in history.

Budgeting the money is something else. Once a program is approved, the maximum amount authorized is not flexible. Once a Government contract for goods or services is placed, the dollar figure is the limit. On contracts or programs covering several months or years, cost does become very important both to the Government and to the contractor.

The problem to the military budget people resolves itself into how to control the pressure of labor and material price increases over the 1-, 2-, or 3-year period between the approval of a program and the final execution of the work.

Part of the answer is by applied powder metallurgy. Not only is the Government attempting actively to reduce the cost of military equipment, but the civilian contractor searches constantly to reduce both his estimated cost and to effect savings in certain areas to compensate for increases in other areas.

FOR example, at the time of the Korean war, the M21A4 booster rotor cost the Government and civilian contractors at least 10 cents each. By powder metallurgy the price was first reduced to 6-1/2 cents each, later to 3-8/10 cents each, and over 200,000,000 of them were made. The aggregate saving of more than $12,000,000 was impressive, and it was achieved by the Ordnance-Industry Team.

Part of this saving was reflected in a 15 per cent lower material consumption which came about because the sintered brass rotors were found to be acceptable at only 85 per cent of the theoretical density of brass. In addition, a scrap loss of 15 per cent was eliminated.

Another way of saving money may be realized by saving direct labor. That saving starts in the toolroom and goes right on through the production plant. A saving in direct labor also creates an indirect saving in overhead charges and manufacturing burden which are applied as a rule to direct labor and are an element of the total cost.

Precision-made sintered iron rotating band blanks ready for assembly to projectiles.

It is of definite economic significance that it usually takes one artisan or one mechanic in the toolroom to produce what, by other metalworking methods, takes up to fifty artisans on the conventional production line. This occurs when the production line is organized either by process or by skills. The skill of the artisan or mechanic is available only at the highest wage rates, and, in addition to money, this skill in time of war is part of another problem.

When a wartime workload is imposed on any plant facility the young mechanic and even the second or third-rating mechanics suddenly find themselves as supervisors. The very men normally counted upon to be available as toolmakers, adjusters, and machine-tool operators are required as supervisors or are pressed into service to train new mechanics. For all practical purposes they are "out of business" or at least their skill is not available directly for production-line work.

Where powder metallurgy can be applied, it needs only a small fraction of the toolmakers otherwise required to make the dies for mass production, and the very men skilled in toolmaking are those available to do the work.

THIS concept extends even to the planning departments, the engineering departments, and the research departments where in time of war the shortage of professional engineers is a problem more serious than is realized generally. If the knowledge of powder metallurgy is included in the engineering skill available to the military establishment, directly or indirectly, the effectiveness of the total engineer personnel available is multiplied many times in one of the key areas and one of the weakest areas of our entire system of national security.

The contribution of powder metallurgy, then, in the solution of the logistic problems of planning, materials, time, cost, labor, and skill is demonstrably important.

A leading trade publication made an interesting study of "User Attitudes on Powder Metal Parts." The report includes the attitudes of Ordnance per-

Typical nonferrous metal powder parts produced to close tolerances in one operation.

sonnel as well as those of approximately 190 industrial users or potential users. The data reported were taken from nineteen per cent of the questionnaires sent out. The objective of the survey was stated to be: "The powder metallurgy industry wants to increase its effectiveness to American manufacturers. In order to do this, it must know what factors have influenced your purchases of powder metal parts . . . or, if you have decided against using powder metal parts, why?" Information was received from the following:

Source	*Per cent of Total*
Ordnance	1.6
Fabricated metal products	9.9
Machinery	37.4
Electrical equipment	18.9
Transportation equipment	12.9
Optical, photo, control and scientific equipment	15.6
Toys, sports goods, novelties	3.7
	100.0

In brief summary this study shows:

1. Nearly fifty-five per cent of the respondent companies now use metal powder parts.

2. Bearings and bushings are currently the most commonly used type of powder metal parts but that structural parts applications are the fastest growing and offer the greatest future potential.

3. Competition for individual customers is intense: nearly fifty per cent of the present users buy from at least three suppliers.

4. The future outlook is bright for continued growth and diversification of powder metal parts applications.

5. Lack of information about powder metal parts is a major deterrent to their broader acceptance and application.

6. Selection of powder metallurgy for the production of a given part and the selection of a supplier are both based largely on joint decisions among management, engineering, and purchasing personnel in the customer's plant.

TAKING a deeper look at some of the data, a few interesting facts may serve as a guide to military planning. Among users of structural parts, 8 per cent reported use between 12 and 20 years, whereas 32 per cent reported they have used sintered structural parts for less than 2 years, an additional 28 per cent for from 2 to 4 years, and an additional 21 per cent for from 4 to 8 years.

The use of structural parts has seen its greatest growth and application since the beginning of mobilization for the Korean war. The use of bearings and bushings dates back for more than twenty years and of course is one of the earliest and most stable applications for powder metallurgy in general use in industry.

The intensity of competition, undoubtedly reflected in the relatively low price of finished parts, is seen in the fact that more than 80 per cent of the users buy from 2 or more suppliers and 50 per cent buy from 3 or more suppliers.

Looking to the future, 80 per cent of present users see a greater use potential for metal powder parts, and among nonusers 57 per cent visualize a future use. Among nonusers, 67 per cent profess they do not have adequate information to design powder metal parts. The study concludes that nonuse of powder metal parts is in many cases apparently a function of ignorance about them.

AMONG all respondents, 55 per cent desire more general information on applications and characteristics; 51 per cent desire cost comparisons; 40 per cent desire data on specifications and materials available; 46 per cent desire metallurgical data, and 41 per cent desire more information on design limitations.

These data are particularly revealing because 55 per cent reported they use powder metal parts and 45 per cent of the sample reported they did not use powder metal parts. Decision as to whether a given piece will be made from metal powders is predominantly a joint decision, although 43 per cent of the respondents report it is an engineering decision. Where the metal parts will be bought again is a joint decision, with the purchasing department deciding in 23 per cent of the cases and engineering deciding in 19 per cent of the cases.

User attitudes stem from use experience, and in the following returns may be seen some of the limitations of powder metallurgy or at least some of the limitations of certain less-skilled powder metal parts fabricators. The need for user education is apparent from these replies:

Source of Trouble	*Per cent of Total*
Exaggerated claims	35.2
Dimensional accuracy	29.4
Serviceability	27.5
Surface finish	15.6
Machineability	15.4
Delivery	5.8
Other	13.2

Powder metallurgy is not going to be the answer to problems in logistics where it has been oversold, underengineered, or where the application simply does not suit the end use. Some of the replies are suspected to be derived from brief experiment only, but they are nevertheless revealing. The results also indicate poor communication between salesmen and user, but whatever the controllable causes may be they are important because they are apt to put a potential user on the defensive.

To project the thought, the ultimate result could be that this user attitude might prevent the Government from taking advantage of a significant contribution because of a single supervising engineer's mental block.

ON the other hand, there is nothing to compel a Government engineer or a decision-making official to commit himself to a process or a product in which he does not have confidence. Too much is at stake to proceed without certainty beyond the stage of limited experiment.

This is by no means a new problem. In many ways the user attitudes expressed in the early days of die castings are similar to those expressed recently by the users of powder metal parts. Both groups desired more facts on costs and design factors, in that order. But this is an underlying problem not exclusive to these two industries, and the Ordnance Corps of the Army has done a superb job in solving the problem.

There is always a best way of doing things. It may not be by powder metallurgy, and in some cases it is definitely not by powder metallurgy. That question is only resolved as a rule, however, after other alternatives, materials and methods have been considered.

Secondary Ordnance Items

Computation of requirements has been facilitated by establishment of a Requirements Branch, supply control points, personalized liaison, and publication of an Ordnance manual on control policies

Charles W. Fauroat

"COMPUTATION of secondary item requirements," a function all too often relegated to stepchild status by the military services, has assumed a new aura of importance in the Army Ordnance Corps as the result of an aggressive reorganization program of a year's duration.

The "new look," created under the direction of Maj. Gen. J. H. Hinrichs, Assistant Chief of Ordnance for Field Service activities, will be found extremely satisfying by both the budget-minded and those with a logistic interest.

The motivating force behind the program, stemming from the date when General Hinrichs assumed charge of Ordnance Field Service activities, was his curiosity and concern over a spare-parts system which resulted in procurement demands as high as a billion dollars a year.

A COMPACT staff of requirement and distribution specialists, headed by Lieut. Col. Ralph McMahon of the General Supply Branch, was dispatched to appraise objectively operations at the six decentralized offices located at the Ordnance Tank Automotive Command, Rock Island Arsenal, Frankford Arsenal, Redstone Arsenal, Rossford Ordnance Depot, and Raritan Arsenal.

The results of the survey, while not alarming, indicated many areas where improvements could be made. Each of the control points had met the challenges of supply in its own way, with varying degrees of success. But, unquestionably, there were six different systems of requirements computation in operation, six different sets of local rules and regulations, and even different terminology for transacting requirements business.

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This "language barrier" was particularly frustrating, the group reported. An understanding of how the "AQI" ("average quarterly issue") was developed at one installation was completely obliterated at the next establishment when the method for arriving at the "FMID" ("future monthly issue demand") was proudly discussed.

The proper course of action was apparent—installation of uniform policies and procedures but with sufficient latitude and flexibility to maintain individual control point operational interests. Immediate steps were taken to achieve this goal, including:

1. Establishment of a secondary-items section in the Requirements Branch, Office of the Chief of Ordnance, providing, for the first time, a regulatory office devoted exclusively to secondary-item requirements.

2. Establishment of supply control points at the six field installations in conformance with Department of Army policy that requirements (supply control) be functionally distinguished from distribution (stock control). Physical proximity of the stock control and supply control points was retained to ensure closest possible coördination.

3. Establishment of personalized liaison by specially trained Ordnance Office consultants, with visits to the supply control points on a predetermined schedule. The value of these visits to both the Ordnance Office and the operators in the field has been enhanced by religiously pursuing a policy of "assistance, not inspection."

4. Publication of Ordnance Corps Manual ORDM 3-6, entitled "Supply Control Polices and Procedures," on October 15, 1954, providing pertinent organizational and operational guidance in requirements within one document for the first time in Ordnance history. Already acclaimed and accepted as a valuable aid by the six supply control points, the manual will be expanded and revised as often as necessary to keep pace with Department of Army policy changes.

HAS this approach paid off? Merely to answer "yes" would be a gross understatement. New and sometimes unanticipated dividends turn up almost daily, making complete appraisal difficult. For example, Ordnance has been able to keep apace—or often ahead—of a vigorous paralleling program initiated

by Department of Army, G-4, and now carried on by the newly designated Deputy for Logistics.

The awareness of the importance of supply control by Department of Army, Department of Defense, and Congress has been the open door to greater confidence in Ordnance's management of its spare-parts business.

SO much for the over-all picture of Army Ordnance supply control as we find it today. Let's now explore the logistic potential in peace and war under the new program and, at the same time, explain how parsimoniously John Q. Taxpayer's dollar is being handled.

Requirements are expressed in two ways: quantity and dollars. It is obvious that all requirements are developed on an item basis, but the translation of item demand into understandable, controllable budgetary data has been a harassing problem. Ordnance's solution was development of a Control and Statistics Branch in the supply control point, functionally aligned to parallel the activities of the basic Requirements Branch.

Item data produced by requirements specialists are rapidly converted into mobilization and budget studies in the new organization by personnel who are all the more objective because they are not burdened by the overriding demands of day-to-day supply.

Further, even as this is written, an additional refinement is being adopted —the Ordnance segment of the Army Stock Fund. This operation, a story in itself, is bringing skilled accountants into the supply control picture to design and maintain ledgers, balance sheets, profit and loss statements, and to analyze the numerous statistics being accumulated.

The Stock Fund objective is to manage the procurement (or manufacture) and distribution (sale) of Ordnance matériel on a more businesslike basis. The benefits can be listed as: cash always available for purchase of items when needed or when advantageous to the Ordnance Corps without fiscal year limitation; elimination of much-deplored frantic year-end spending (since funds do not expire); development of more effective analysis of operations through fiscal and budget data hitherto unavailable; and portrayal of Ordnance budgetary needs (or accomplishments) in business terms more readily understood at higher echelons.

One question remains unanswered: Will the Stock Fund we effective in the event of a national emergency?

Heart and soul of the entire supply control operation is the development of the individual item requirement. The challenge and responsibility are tremendous since to overestimate is as sinful as to underestimate your needs—possibly more sinful, since the average visiting or inspecting dignitary seems to take a more charitable view of a bare or near-bare shelf than a warehouse crammed with "widgets" which can't possibly be consumed in the next ten years.

The basic formula for a requirements computation may be simply stated: past issue (or consumption) experience factored by projected major-item densities and utilization and/or troop strength. However, it's the intangibles and uncontrollables which bring headaches and gray hairs to prognosticators of next year's needs.

IS the equipment being supported fairly new or wearing out? How much outright obsolescence will be announced in the succeeding twelve months? How about gains and losses in depot stocks due to improper inventorying and errors in stock status reporting? Can we provide for outright losses incurred in shipping and handling between facility, depot, and customer—particularly overseas? Are we in a position to compensate for delays in deliveries because of transportation tie-ups, strikes, or other work stoppages in facilities, or inspection rejections?

"Heart and soul of the entire supply control operation is the development of the individual item requirement. The challenge and responsibility are tremendous since to overestimate is as sinful as to underestimate your needs—possibly more sinful, since the average visiting or inspecting dignitary seems to take a more charitable view of a bare or near-bare shelf than a warehouse crammed with 'widgets' which can't possibly be consumed in the next ten years."

The Ordnance requirements operator has been oriented to view overcomputation as a serious blemish on his escutcheon of accomplishment. In peacetime, he puts on his taxpayer's hat and recognizes the waste of funds in purchase, distribution, and storage of excess stocks. In time of emergency, his logistics training permits comprehension of the fact that inflated demands deprive others of vital raw materials and production facilities.

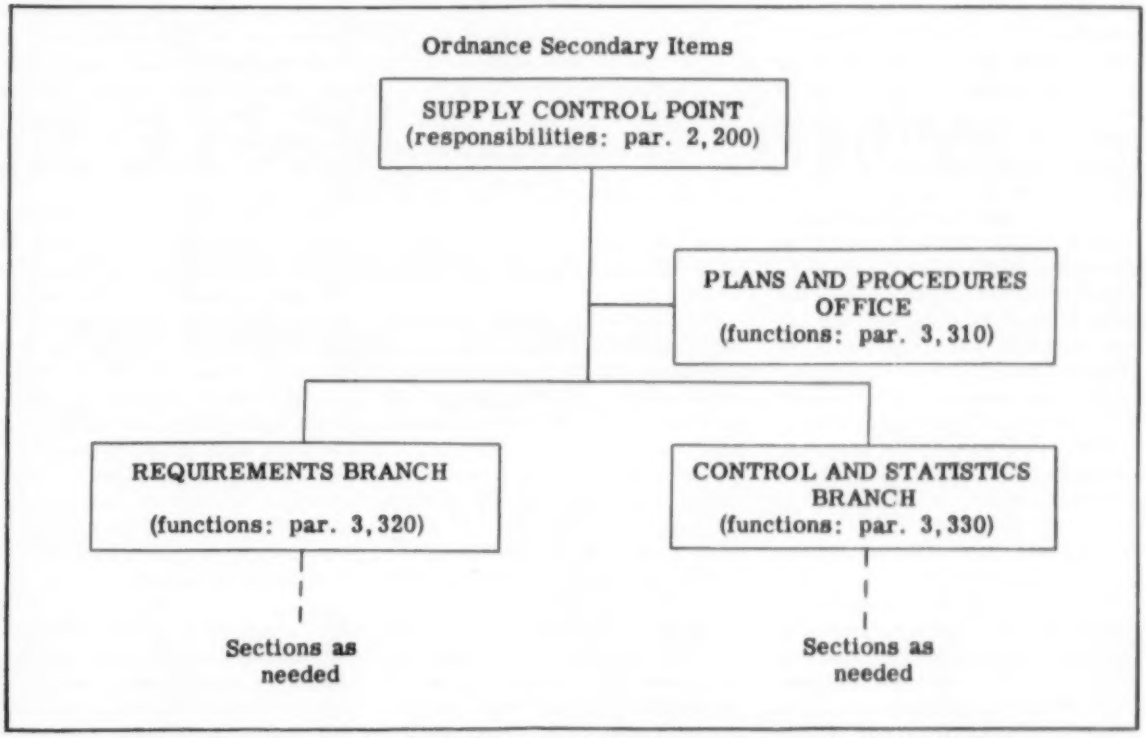
ORDNANCE'S "new look" of uniformity has provided the decentralized supply control points with new and valuable operating aids. Not the least of these is the previously mentioned Policy and Procedure Manual, ORDM 3-6, a veritable treasure-trove of guidance information. Eleven numbered paragraphs on "responsibilities" completely cover the operational scope from accumulation of worldwide asset and issue data through budget control and actual computation of requirements to disposal of surplus matériel.

Supply control itself is aptly defined as "the process by which, through a system of reports, computations, and evaluations, all asset and demand data pertaining to an item of supply are assembled and balanced through procurement, rebuild, or disposal."

The purpose of a supply control point is summarized as "accomplishment of a position where normal depot stocks are on hand and deliveries from procurement arrive at a rate commensurate with issues, and for the prevention of overstockage, understockage, and budget distortion while maintaining adequate supply."

OF particular interest is the supply control point organization chart (see page 721). A Plans and Procedures Office has been created providing strong staffing support to the two operation branch elements and clarifying what has been a rather nebulous area up to the present time. The Requirements Branch is described in detail as the actual computing operation, including mobilization phases. The Control and Statistics Branch is equally as well identified, with reports and special studies as the end product and with maintenance of essential supporting records as the principal occupation.

The clean lines of authority, elimi-



Ordnance Corps Secondary Item Supply Control Point Organization Chart, effective October 15, 1954.

nating overlap and duplication, will gladden the hearts of personnel or management officials who take the time to explore this document. All supply control points have completely converted to the new organization alignment or are in the process of final conversion.

The actual computation of a secondary-item requirement is covered in a seven-page section of the manual, including instructions for the use of Ordnance standard supply control study Form 1778. This latter ingenious work sheet and requirement record has been through the crucible of long-range contemplation, and is not a hastily thrown together document prepared to meet a publication deadline.

TWO separate meetings of the supply control points and interested Ordnance Office staffers helped produce the present form which has already received the blessings of the Army Dep Log requirements group. An open mind has been retained. Revision of the present format will be undertaken by Ordnance whenever deemed advantageous to the operating elements.

Although the mechanics utilized in completing a supply control study are quite detailed, even casual perusal of Form 1778 shows obviously important areas of consideration. Pipeline control, a subject of frequent crusading by higher authority, is firmly maintained by using prescribed guides on "lead time."

"RETENTION levels," the gateway to adequate reserve stocks and disposal actions, are controlled through the "Stock Position Summary." The "Elements of Supply Control" cover the broad basic fields of recurring and nonrecurring issues, including "customer" categories and "due outs," and the consideration of total requirements against total assets; *i.e.*, stock on hand, returns, repair, and all outstanding procurement.

Permanent-type data which must be considered in the final computation are entered on the topmost part of the form. Each study, when completed, becomes a self-contained, documented action paper leading up to one of the actions contained in Sections V through Z (Maintenance in Storage, Rebuild, Return of Overseas Stocks, Procurement or Procurement Cutbacks, Repair Cutbacks, or further study).

A proper question at this time is whether or not the "new Ordnance look" will hamper the supply control points in applying existing directives to their own commodities. Commodity responsibility alignment includes combat and general-purpose vehicles at the Ordnance Tank-Automotive Command; weapons at Rock Island; fire control at Frankford; guided missiles at Redstone; tools and equipment at Rossford; and radio-controlled aërial targets, common hardware, and cleaners and preservatives at Raritan.

The answer is an assured, positive "No," and current examples of individuality may be cited.

AT Raritan Arsenal an electrical accounting machine method for reviewing all items prior to detailed study on Form 1778 has been retained with approval of higher headquarters. Observance of the system's performance over a 2-year period has resulted in the intriguing suggestion by its sponsor that the system may be suited to supply control of "confetti-type" (low dollar value) items without additional manual review.

Interested Department of Army and Ordnance Corps officials have conceded

two important benefits in the Raritan operation: (1) savings in manpower and (2) rapid yet controlled expansion in time of emergency. There is as yet no unanimity as to the quality of the goods being produced although the arsenal's records support an almost unbelievable saga of accuracy.

An even more far-reaching experiment is the current installation of an electronic data processing system for inventory control of automotive secondary items at the Ordnance Tank-Automotive Command. The installation of the equipment, being accomplished by one of the largest concerns in the electronic field, will permit integration of supply control, stock control, and cataloging operations into a single system. It provides for automatic maintenance of files on a daily basis and elecronic review of Ordnance supply status at any time such review is required.

A perpetual inventory record will be maintained on a magnetic tape with feeder reports being received from each depot, including dues in, on hand, stock objectives, and a summary of past demands. Catalog data and changes will also be maintained on magnetic tapes, permitting release or recapitulation of this information with fantastic speed.

In the specific field of supply control, the electronic devices will permit requirement studies based on actual past demands compared with estimated past demands, future demands predicted from carefully evaluated feeder data, and budget data and studies in whatever form is required.

Another benefit of the system will be a daily review of total assets, with replenishment of stocks being recommended by the system when assets fall below reorder level.

OFFICIALS connected with the development and installation of the OTAC project are confident that the electronic data processing system ultimately will replace all existing methods of operations. In addition to the obvious savings in personnel, the potential for maintaining current operations has never before been approached, even during times of emergency.

And these experiences are being repeated at the other installations. Rossford, with its tools and equipment mission running high in nonexpendable items, has developed special controls for reflection and analyzation of "initial issues."

"One of the most satisfying facets of the new supply control program is the manner in which day-to-day operations have been dovetailed into the broader Ordnance picture."

Rock Island has gleaned extraordinary operational efficiency in as simple a mechanism as the physical placement of the supply control operator at the desk next to his stock control counterpart.

Frankford has earned a bow as the originator of what ultimately emerged as Form 1778, and Redstone, newest member of the family, is constantly meeting the challenge of new problems created by the guided-missile mission.

Additional assistance in the "What shall I buy for next year?" problem (to paraphrase the housewife's age-old question) is expected from a comparative newcomer on the scene, the Ordnance Supply Demand Analysis Agency. Conceived and nurtured by the Ordnance Board at Aberdeen under the unassuming title "Project 170," this stock-control system for the field soldier passed the acid test with flying colors when it was installed and utilized in Japan and Korea during the recent emergency.

AVAILABILITY was purified at the same time that tonnage of stocks decreased because the system is based upon actual consumption rather than issue experience. Dignified by official status less than a year ago, the project was retitled the "Ordnance Supply Demand Analysis Agency" and moved to Raritan Arsenal.

Trained technicians, working out of the arsenal, are now completing installation of the system in the Continental United States armies, and will shortly move into the European theater to continue the worldwide picture.

Already convinced that better stock control means better supply control, operating officials are carefully appraising another product of the agency—the compilation and reporting of parts consumption on a major-item basis. Not only are these data expected to provide assistance to the supply control operator but are also usable in the refinement of section 7 and 8 supply manuals. The Ordnance Supply Demand Analysis System is under consideration by Department of Army staffers at the present time for similar adoption by other technical services.

One of the most satisfying facets of the new supply control program is the manner in which day-to-day operations have been dovetailed into the broader Ordnance picture. Taking full advantage of being a part of what has been tentatively retitled the "Field Service Supply Management Agency," supply control point personnel consult early and often with their counterparts in the maintenance and stock control points located under the same roof. For unresolved problems, there is an agency staff to appeal to, headed by a military or civilian chief or both.

NO longer is it possible to rebuild equipment unless such rebuild is justified by a supply control study. This particular coördination has been developed to the point where the maintenance point's rebuild budgets are based —and properly so—on projected requirements data. Similarly, disposal and local purchase authorizations by the stock control point are dependent wholly and entirely upon supply control guidance.

Awareness of the importance of this close coördination is not held by Ordnance alone. Requirements teams of the Deputy Chief of Staff for Logistics which now survey supply control point operations semiannually, include maintenance and stock-control experts in their make-up.

The present and projected establishment of Commodity Commands by the Chief of Ordnance, Maj. Gen. E. L. Cummings, places the Corps in an even more favorable position. The coördination potential of Research and Development, Industrial Service, and Field Service functions under one roof on a commodity basis almost escapes the bounds of imagination.

Possibility of criticism for having portrayed too pretty a picture is recognized by the author, but the facts speak for themselves. Progress to date literally amounts to Ordnance lifting itself by its bootstraps in the field of secondary item supply control.

Towed Gun Carriages

When the chips are down in an all-out conflict, towed artillery has many advantages in economy of materials, mass producibility, and a high degree of mobility, resulting in effective firepower

N. S. Glassman

Mr. Glassman is chief of the carriage section, Artillery Branch, Office, Chief of Ordnance, Washington, D. C. This article is taken from an address given by Mr. Glassman before a recent meeting of the American Ordnance Association's Artillery Division, held at Rock Island Arsenal, Rock Island, Ill.

CONCERNING the job of translating policy to engineering, I should like to tabulate the precepts, isolated from the weapon system considerations, which must control the "new look in towed artillery carriages." These are not new considerations. They are merely emphasized by competitive weapons in other fields and by combat capabilities of potential enemies. The sequence of this listing is not entirely significant. There are circumstances which would make one quality more important than others, but when compromise is necessary something must give.

Our designers are told to build a weapon which weighs nothing, shoots farther than anything, never needs repairs, and can be built without using any materials—least of all materials which could conceivably be used for aircraft. Translated, this means: (1) mass producible, (2) lightweight, (3) mobile, (4) rugged, (5) powerful, (6) reliable, (7) accurate.

IF I must single out the most important on this list, I will say that light weight has become paramount. Obviously you shudder when I say that the 280-mm. weapon is lightweight, but it is! I shall not bore you with statistics as to how favorably its foot-tons of energy per pound of weapon compare to the 240-mm. howitzer, nor shall I elaborate on the excellence of mobility of the little 76-mm. antitank towed gun carriage. Suffice to say that fifteen years ago those features would have been considered "blue-sky."

Weight is, of course, relative—but it is fundamental. We know of foreign weapons which weigh less than our counterparts, but, because of the relativity aspects, we are not too concerned. The explanation is obvious. If we can outshoot, outmaneuver, and outproduce in quality and reliability the closest enemy counterpart, we are still in a favorable position.

This problem of weight has really several basic aspects: (1) we must obtain economy of materials; (2) we must have mass producibility; (3) we must have a high degree of mobility.

If any one factor urges towed artillery in the long-term arsenal of defense, it is the superiority in these aspects. When the chips are down, the proven dependability of towed weapons in large numbers and in mass firepower becomes most useful.

In recurring directives from Staff, air transportability is stressed. While we can carry the 155-mm. howitzer and its prime mover several thousand miles in hours, the self-propelled gun will move the same distance in days. Even with attendant difficulties, the 280-mm. weapon and its vehicles can move from within our borders to defend a battle-line abroad in a day or so, while a self-propelled weapon might take weeks.

WHEN we look at a gun we recognize that it is simply a unique heat engine which has the primary function of delivering a shell to a distant point with as much consternation to the enemy as possible. It is a fundamental truth that the simplest machine which can do the required job is the best—whether it be a rolling mill or a can opener. Not only must it be simple, it must be dependable; and not only dependable, but available. Therein lie the virtues of towed artillery, and the key to those requirements is in the phrase "to do the required job."

Nothing could be simpler than the old shipboard cannon that rested on a wooden platform with wheels, snubbed by ropes or what-not—but nothing would be as inappropriate today. Our job then, becomes that of choosing complexities as necessary evils which lead to desirable over-all qualities. At the risk of being boring, I again point to the 280, with its auxiliary power (unheard of a few years back for field artillery), with its double recoil, and its unique transporters. The complexities

have met with unqualified acceptance in many areas.

Thus I come to the major thought in this presentation. I limit it to field artillery for various reasons, but the principles can be extended to antiaircraft or antitank weapons. There are many other aspects vital to the weapons we live with—better recoil systems, components engineered to the human operators, improved ammunition, etc. I want to suggest to those who represent the talents of our industry and are aware of problems in gun carriages and mounts that towed artillery will continue until newer concepts can provide complete substitution.

WE need to accept minor complexities which will furnish major improvements to the simple weapon:

1. Power on carriage to furnish the push for the last 100 yards across unfavorable terrain is one prospect. We have been thinking in terms of gasoline engines but are not quite willing to accept the current degree of complexity arising. There is a large unexplored field in this direction.

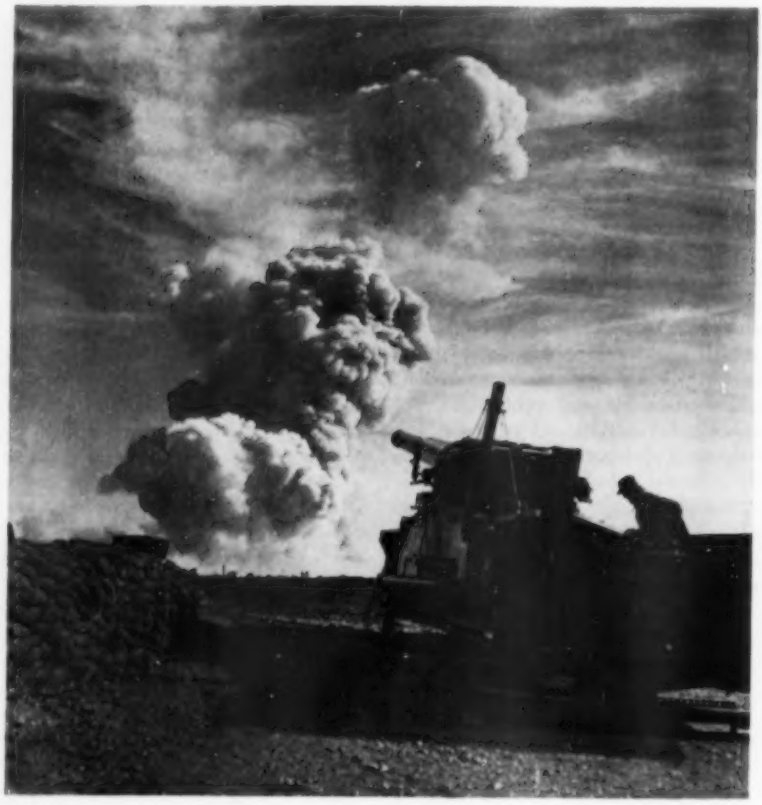
2. Power to assist in quick emplacement and disemplacement is another prospect. Time is of the essence here.

3. Reduction in weight which might be possible by new materials without sacrifice of stability or durability. This approach almost necessarily carries with it a change in basic geometry of carriage, lower trunnion, new methods of fixing to the ground, and other methods of absorption of firing loads.

4. New methods of transport, without the expense and complexity of self-propelled vehicles.

5. Protection of crew from radiological as well as fragmentation dangers, but without the weight of armor which becomes a burden on the mobility and simplicity of towed weapons.

OUR big job is to depart from fixed ideas and preconceived notions of what a towed carriage should be. If it turned out to be a weapon with the gun mounted under an axle or on a carriage which had no trails but with all this had high power with light weight, and simplicity with versatility, and ease of operation with minor complexities it could very well be the backbone of our defense at a cost which could ensure its availability in any crisis.



Above, artillerymen fire a 155-mm. howitzer during the recent Korean conflict. Below, an atomic shell is test-fired from the 280-mm. gun (Army photos).

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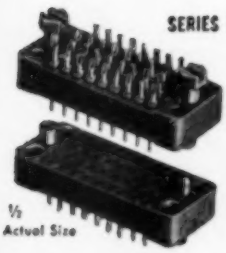

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Contacts: 7, 8, 9, 11, 14, 18, 20, 21, 26, 34, 50, 75, 104. For #20 AWG wire. Current rating: 5 amps. Voltage: 2100V. RMS.

SUB-MINIATURE

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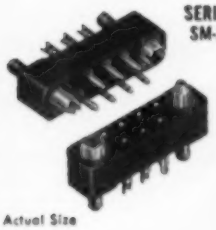

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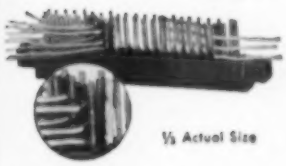

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HIGH VOLTAGE AN-TYPE

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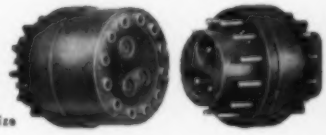
For AN-36 shell. 15 contacts. 3 high voltage contacts in center are removable. Current ratings: 10 and 20 Amps.



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EASY RELEASE

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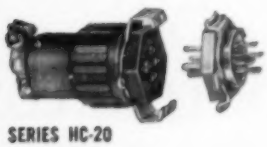
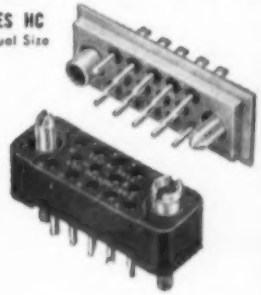


SERIES HC-20

¾ Actual Size

SERIES HC

½ Actual Size



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"We descried a herd of buffalo about two miles distant, scattered apart and quietly grazing near a small strip of trees and bushes. Taking a wide circuit, we moved slowly and cautiously . . . then galloping along parallel, I singled out a buffalo and by a fortunate shot brought it down on the spot"—so wrote author Washington Irving of a hunting trip out West.

Yes, the hand that immortalized Rip Van Winkle and Ichabod Crane felt right at home around a rifle stock. Whenever Irving looked for relaxation, we're told he would take his gun and track the forests of Sleepy Hollow for fox, pheasant, duck or deer. Sometimes he made a kill—sometimes he didn't. But losing a quarry never spoiled his day. Hunting thrills and the healthy outdoors gave him a new outlook . . . brought him pleasure and sent him home refreshed.

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	Page
AC Spark Plug Division, GMC	661
ACF Industries, Incorporated	556
Aero Design & Engineering Company	571
Aerojet-General Corporation	634
Aetna-Standard Engineering Company	658
Allison Division, GMC	703
American Machine & Foundry Company	700
Arma Division, American Bosch Arma Corporation	IV Cover
Arnold Engineering Company	649
Atlas Precision Products Company	638
Avco Defense and Industrial Products, Crosley Division	582
Bausch & Lomb Optical Company	558
Bell Telephone Laboratories	575
Bendix Aviation Corporation	550, 648, 663, 684
Bliss Company, E. W.	687
Bundy Tubing Company	559
Burroughs Corporation	577
Caledonia Electronics & Transformer Corporation	670
Cameron Iron Works, Inc.	685
Chance Vought Aircraft, Inc.	674
Cincinnati Milling Machine Company	631
Clark Equipment Company	691
Clary Corporation	669
Cleveland Container Company	576
Cline Electric Manufacturing Company	566
Consolidated Diesel Electric Corporation	693
Consolidated Vultee Aircraft Corporation	III Cover
Continental Motors Corporation	565
Dana Corporation	671
Danly Machine Specialties, Inc.	555
DeJur-Amsco Corporation	725
Dempster Brothers	704
Douglas Aircraft Company	677
Dow Chemical Company	673
DuKane Corporation	665
Du Pont de Nemours & Company, E. I.	659, 726
Eastern Tool & Manufacturing Company	569
Eaton Manufacturing Company	660
Emhart Manufacturing Company	552
Exact Weight Scale Company	690
Fairchild Engine and Airplane Corporation	639, 655
Fellows Gear Shaper Company	644
Ford Instrument Company, Division Sperry Rand Corporation	702
Foster Wheeler Corporation	564
Fuller Brush Company	668
General Precision Equipment Corporation	678
Glidden Company	641
Gottscho, Inc., Adolph	666
Gray Manufacturing Company	653
Great Lakes Steel Corporation	561
Gulf Oil Corporation	670
Harvey Aluminum Sales, Inc.	563
Heckethorn Manufacturing and Supply Company	689
Hoe & Co., Inc., R.	572
Hollandse Signaalapparaten, N. V.	651
Hunter Douglas Corporation	635
Hycon Manufacturing Company	578
International Nickel Company	656
Kaiser Aluminum & Chemical Corporation	698
Kollmorgen Optical Corporation	668
Lapointe Machine Tool Company	633
Lear, Inc.	567
Lehigh Chemical Company	694
LeTourneau, Inc., R. G.	642
Lurie Engineering Company	584
Magnethermic Corporation	557
Magnetic Metals Company	650
Mallory-Sharon Titanium Corporation	632
Markem Machine Company	664
Marquardt Aircraft Company	574
Martin Company, Glenn L.	568
Mason & Hanger-Silas Mason Company	680
Minneapolis-Honeywell Regulator Company	708
Motorola, Inc.	562
National Malleable and Steel Castings Company	632
National Northern, Division of National Fireworks Ordnance Corporation	580
National Tube Division, U. S. Steel Corporation	692
New Departure Division, GMC	695
New York Air Brake Company	681
Niagara Blower Company	690
Norris-Thermador Corporation	662
Northrop Aircraft, Inc.	667
Oakite Products, Inc.	560
Olin Mathieson Chemical Corporation	574
Oliver Corporation	581
Oliver Corporation, A. B. Farquhar Division	657
Perkin-Elmer Corporation	696
Pioneer Engineering & Manufacturing Company	666
Pyle-National Company	636
Radio Corporation of America	675, 701
Raytheon Manufacturing Company	683
Reaction Motors, Inc.	574
Reeves Instrument Corporation	643
Remington Arms Company	640
Rheem Manufacturing Company	579
Sperry Gyroscope Company, Division Sperry Rand Corporation	697
Stewart-Warner Corporation	647
Strom Machinery Corporation	664
Stromberg-Carlson Company, Division General Dynamics Corporation	706
Surface Combustion Corporation	554
Texas Instruments, Inc.	646
Thiokol Chemical Corporation	637
Timken Roller Bearing Company	II Cover
Tung-Sol Electric, Inc.	686
U. S. Hoffman Machinery Corporation	707
U. S. Industries, Inc.	728
Vard, Inc.	645
Verson Allsteel Press Company	570
Wolverine Tube Division, Calumet & Hecla, Inc.	553

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It takes two experienced fliers—the pilot and the landing signal officer—to make a carrier landing. In the same way, two great sources of experience work together at American Bosch Arma Corporation. The recent merger joins American Bosch's cost-saving mass production techniques with Arma's expert technological skill. Result: American Bosch Arma Corporation can now provide Engineering and Manufacturing facilities capable of producing the most accurate and reliable electrical and electronic equipments yet produced —equipments the Armed Forces *must* have for the defense of our nation.

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